MAR 9 1925

RAILWAY ISSUE

March 5, 1925

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

TRACKLAYING ON THE ILLINOIS CENTRAL IN KENTUCKY

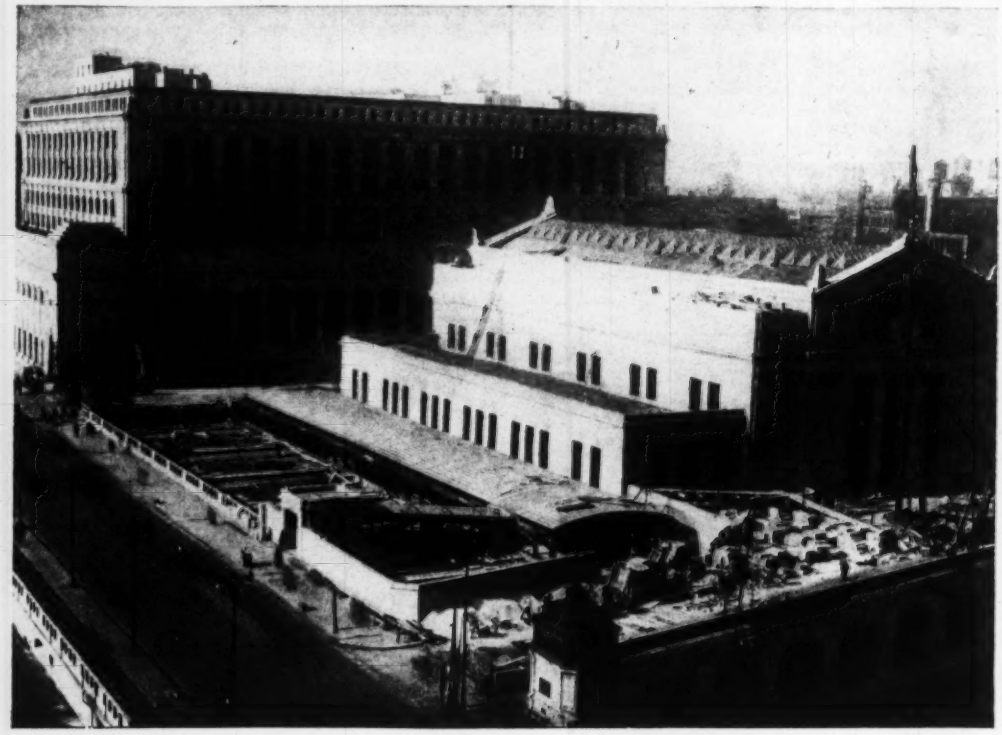
RAILROAD ARTICLES IN THIS ISSUE

New Line Construction
- Union Pacific's 95-Mile Idaho-Nevada Line
- Rush Work on Natron Cutoff of Central Pacific
- Illinois Central's Work in Kentucky

Line Improvements
- Baltimore & Ohio's Pittsburgh Track Elevation
- Double-Tracking and Relocation on the Santa Fé

Administration
- Progress Toward Railroad Consolidation

ALSO: A number of shorter articles, including half a dozen "Job and Office" hints



Concourse of Union Passenger Station, Chicago, now under construction. Federal Cement Tile used. All of the train sheds, extending for three-quarters of a mile along the river, are also being Federal roofed. Graham, Anderson, Probst & White, Architects. Joshua D'Esposito, Engineer.

The ideal roof for railroad structures

It is because Federal Cement Tile is so well suited to railroad buildings and at the same time most economical when compared with other materials affording equivalent service that it has been chosen for the great new Union Passenger Terminal at Chicago and numerous other important railroad installations.

Federal roofs withstand smoke, gas, steam and cinders permanently without a sign of deterioration. They are economical. They require less structural steel than other types of permanent roofs. Architecturally they are always most satisfactory.

Federal Cement Tile for all pitched and flat surfaces are precast of reinforced stone concrete and are made in four styles: interlocking, glass insert interlocking, channel and flat slab.

Some railroads now using Federal Cement Tile

Illinois Central
Chicago & Northwestern
Chicago Rock Island & Pacific
Baltimore & Ohio
Chicago, Burlington & Quincy
Chicago & Eastern Illinois
Grand Trunk
Pennsylvania
Chicago & Western Indiana
Louisville & Nashville
Union Pacific
Missouri, Kansas & Texas
Cincinnati, Indianapolis & Western
Chicago & Great Western
Aurora, Elgin & Chicago
Indiana Traction Lines

Made, laid and guaranteed by

FEDERAL CEMENT TILE COMPANY

608 Dearborn St., Chicago

FEDERAL Cement Tile

"The Roof for Permanence"

ENR3-21-RTG

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

McGraw-Hill Company Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, MARCH 5, 1925 Number 10

The Late Departed Congress

MARCH four this quadrennial year was not the usual political landmark. Mr. Coolidge rode back from the capitol the same person who rode down to it—and the administration of government was not disturbed. One important thing happened, however. The Sixty-Eighth Congress went out of existence. How much of the inefficiency of that congress was due to the political conditions at its election and its consequent party and bloc alignment and how much to a change in the operation of representative government, the next few congresses will show, but it is certain that if the do-nothing and obstructive tactics of the late congress are continued in its successors, those who despair of the republic will begin to take on the mantles of prophets.

Anything but "Logical"

IN the editorial discussion last week of Pennsylvania's new "giant power" scheme, an impish linotype made us say that Governor Pinchot waxed positively "logical" in his prefatory picture of the Utopia that the Keystone State would become under the beneficent reign of electricity made for about nothing at the mine and transmitted for but little more on common carrier wires to every hut, apartment and mill from the Lake to the Bay. Nothing could have been further from our intention than to accuse the governor of being logical. What was written was "lyrical"—and we hasten to make amends.

Regional Road Associations

ASSOCIATIONS of road officials have multiplied until the thoughtful observer is bound to inquire what service different from that already provided any new organization can promise. This is the test that must be applied to the Association of Highway Officials of the North Atlantic States so successfully started last week by the meeting at Atlantic City, N. J. As the name indicates the new association is regional. Like the Mississippi valley states association and the Pacific coast states association, its object is to gather into conference the road builders of a group of states whose highway problems are substantially alike and, in general, of a different kind from those of any other group of states. Holding itself to its regional character and confining its efforts to its outstanding regional problems the new organization can render a valuable service to its own group of states and only a little less remotely to other groups of states. This is precisely the service for which the older regional associations have made notable reputations for themselves. There is today no better work being done by any organization of highway officials than that of the baker's dozen of states which make up the conference of Mississippi valley states highway departments. And this work in no way competes with or duplicates the labors which more properly belong to the associations of national membership. With its present distinctively regional road problems of maintenance, reconstruction and traffic congestion, the North Atlantic states association can perform a task for which no other group of road builders is so well equipped. Every road engineer will wish it success in its special field of opportunity.

A Plea for Simplicity

BETTER concrete is being made today than ever before. More is known about the necessities which lie behind the making of this better concrete. More constructors, both engineers and contractors, realize that concrete is by no means permanent if made by rule-of-thumb or in disregard of rule. And yet those who know how to make good concrete are a long way from getting their knowledge across to those who do not know. Last week at the American Concrete Institure meeting at Chicago this thought was inescapable. If one pictured a well-intentioned concrete man, new come to the higher discussion of the intricacies of concrete but anxious to learn—if one pictured him at the sessions of the Institute, it would take more than usual optimism to assume that he would have learned much that he could have taken back. The intelligentsia of the concrete industry will have to come down to earth if they expect to get ahead much faster in their propaganda for better concrete. They will have to talk more the language of the mixer man than of the laboratory assistant. They will have to come to some agreement on the simple fundamentals of proportioning rather than to have several methods, all rather formidable to those unused to mathematics. They will have to impress on the ordinary user that there is a middle ground as to water content, which will permit the concrete to flow freely between closely spaced rods and at the same time not be soaked with water to the detriment of strength. These things can be done, but if one listens to discussions of concrete today in the assumed guise of this receptive but uninstructed concrete man, he will hear much that confuses and only little that helps. We need to stop awhile and take stock.

A Question of Degree

SEWAGE disposal by dilution is characterized as "archaic" by the Cleveland *Plain Dealer* in a long editorial condemning Chicago's attempts to get authorization of a 10,000-sec.-ft. diversion of lake water to dilute its gulfward-turned sewage. There is today no practicable system of sewage disposal that does not depend upon dilution to some degree. Sole dependence upon dilution is warranted when there is water enough that can be used for the purpose without injury—one might say unreasonable injury—to prior or superior rights. The *Plain Dealer's* own city discharged all its sewage into its own lake waters until quite recently and has yet completed but two of three treatment

plants required to treat its entire sewage. Dilution is relied upon in large degree at the completed and projected plant. In principle, this is good sanitation and sound economics, at Cleveland and everywhere else. The only question at issue is the warrantable degree of reliance on dilution alone and where this is insufficient the degree of supplementary treatment required. Chicago has already under execution an immense project for sewage treatment works to supplement dilution—not because dilution is archaic but to meet changing conditions; much as Cleveland itself did when sewage treatment was adopted.

Meeting City Replanning Costs

HOW to meet the heavy costs of city replanning is a question confronting many cities today. We do not mean elaborate programs designed to make an ill-planned or unplanned city ideal overnight but the sort of emergency piecemeal planning, like street widenings and opening up dead ends, that recent heavy traffic increases are forcing upon cities large and small, the country over. When part only of the needed "intermediate" thoroughfare improvements at Boston is estimated to cost $25,000,000, as noted in our issue of Feb. 26, the seriousness of the economics of the problem is apparent. The Boston commission reporting on this subject accepted as one fundamental that the cost of the project covered in its report should be added to the long-term bond issues of the city. It advised a division of the burden between street users and realty owners. That is it proposed (1) that all city revenue derived from motor vehicles should be devoted to the project and (2) that the remaining cost should be raised by two tax levies on real estate, 50c. on the $1,000 for the whole area of the city and a like rate for the central district of the city. To finance outlays as they occur, bonds running not over 15 years were advised. In effect, the charges on real estate would be somewhat of the nature of a special assessment for benefit, with a determination in advance, by the state legislature, acting on the advice of a commission it had created, that all the real estate of the city was benefited at one rate and the central district of the city at double that rate. The plan has the merit of simplicity, uniformity and of recognizing the benefit principle, first as regards street users and second as regards real estate. With modifications to meet the local conditions it deserves consideration in other cities that are attempting to meet pressing street traffic conditions.

Rate Regulation by Congress

IN one of its many moments of thoughtless action the Senate, spurred on by the concerted efforts of organized travelingmen as well as by the very general unpopularity of the Pullman surcharge with everyone, including members of Congress, who can afford to ride in Pullman cars, on Feb. 13 passed the Robinson bill prohibiting the Pullman surcharge. This action was taken in the face of the decision by the Interstate Commerce Commission, the authorized rate-making body of the country, that the surcharge should remain in effect. The matter of the surcharge itself is not so important, but the fact that Congress has taken it up is important, for if Congress persists in making rates, the Interstate Commerce Commission as a rate-making body will cease to be of value except in unimportant matters. Any important cases if backed by powerful interests who fail to get the kind of action they want from the commission will go before Congress where they can be expected to get the same kind of action as has been meted out to the Pullman surcharge—action not based on a careful consideration of the case on its merits but on political expediency. Fortunately, it appears now that the surcharge legislation is not going to receive the same careless consideration in the House that it received in the Senate. The House Committee on Interstate Commerce has submitted a report adverse to the legislation and the members of the House, the majority of whom seemed to be on the point of repeating the Senate's precipitous action a few days ago, are beginning to see the matter in its real light, and now realize that to pass the bill will amount to a repudiation of the Interstate Commerce Commission.

Improving the Railroads

THE increased operating efficiency of the railroads brought them to the close of 1924 with a greater net operating income than in 1923 in spite of the fact that their gross income was less this year than last. If we look for the reason for this improved condition, we find that besides a great amount of individual effort on the part of railroad officials and employees, which it is impossible to measure, there has been a large expenditure of money for new facilities and equipment, and a notable effort to better financial conditions. To the average citizen the extent of what has been accomplished is not evident because the railroads are poor advertisers, but a glance through the articles on the following pages will give some idea of the character of the work undertaken by the railroads. These articles describe but a few of the many projects, some of which we have noted at some length in the past, such as the Castleton cut-off of the New York Central, and others which we have not as yet described, such as the new 238-mile line across Florida which the Seaboard Air Line recently completed in the surprisingly short time of less than one year.

Except for a few projects like the above, the majority of the projects are for the improvement of existing facilities rather than for opening up new territory. These must justify by direct economies in operation, the large expenditures made in carrying them out, not by developing business as does a new line into undeveloped territory. Electrification such as the Virginian Ry. has under way falls in this class. Many people have feared that the large expenditures required for this class of improvement could not be justified by actual results, and until now there has been available little information on the comparative costs of steam and electric operation. But within the last few days the Chicago, Milwaukee & St. Paul Railway Co. has published figures on the cost of operating its electrified divisions which show such favorable results that they may be expected to spur on other roads to undertaking electrification where the conditions are somewhat similar.

In other departments of the railroads there have been similar improvements. Orders for cars and locomotives continue to be heavy. The interesting developments in locomotive design during the past year were noted in our issue of Jan. 8. In the maintenance of way department the use of treated ties has been ex-

tended and the move toward the use of longer rails has received considerable impetus through the placing of some large orders for 39-ft. rails. Bridge renewals have been numerous and many additions have been made to terminal facilities.

On the financial side a few railroads have been able to switch over from the issue of bonds to the issue of stock in raising new capital—a departure which indicates a definite improvement in the financial status of the railroads. One railroad, the New York, New Haven & Hartford, has just completed a unique piece of financing. Faced with the necessity of refunding a large loan the company made a direct appeal to the industries it served, asking for assistance in floating a new loan to keep it from the bankruptcy court. The response was so generous that it now looks as if the $23,000,000 refunding bond issue would be oversubscribed. At the same time, by selling the securities direct, the company was able to save a considerable sum in brokerage fees.

It is too early to say whether this year will see as much new work in hand as last year, but there is no reason to expect that it will not. The railroads are still so far behind, even on a conservative program of development to meet the needs of the country, that they can hardly do otherwise than enlarge their undertakings as their condition improves.

Railroad Consolidation

IS the much discussed and laboriously prepared plan of the Interstate Commerce Commission for railroad consolidation going into the discard? This question was asked frequently during the past year when so many new railroad mergers either became an accomplished fact or got well under way, some of them being at divergence with the Interstate Commerce Commission's plan. No less an authority than former Commissioner Potter says that it should, and that the railroads should be allowed to work out their own consolidations.

As time goes on and the ease with which voluntary consolidation may be accomplished becomes more apparent and the difficulties in the way of compulsory consolidation more obvious, such a solution of the problem looks like the only way out—if we are to remain committed to the theory that such a general consolidation of the railroads is desirable. If so, no matter how consolidation is effected, the cost of doing it will, in a large measure, determine its success or failure; and the difference between high cost and low cost seems to be the measure of the difference between compulsory and voluntary consolidation. As Commissioner Potter points out, it is one thing for a railroad to go into the open market and buy up control of another railroad, making the best terms it can with the owners, when the owners know that if their terms are not satisfactory the purchasing company will not buy, and quite another thing when the owners know that the purchasing company has a mandate from Congress to buy. Under the latter conditions the stocks of many weak railroads would be forced to fictitiously high levels and the consequent expense of consolidating them with a larger system might offset the economies to be derived therefrom. To prevent the development of such a situation Congress might set up elaborate purchase provisions based on Interstate Commerce Commission valuation, but as the railroads' valuation is far from completion after ten years of work such a plan would put off consolidation indefinitely

However, if voluntary consolidation is to be successful it needs some fostering legislation. The present federal law needs to have the provision for the publication of a consolidation plan by the Interstate Commerce Commission eliminated, and many state laws which oppose any form of consolidation need to be repealed. Then, too, the matter of buying out minority stockholders needs to be so regulated that they can be prevented from holding up the purchase of a railroad and yet have their rights protected. These are not simple problems to meet, but as they are common to either kind of consolidation they must be met if the work is to go ahead. With them provided for, and with the Interstate Commerce Commission authorized to use its discretion in providing conditions for each case as it is presented, railroad consolidaton may become more than an interesting theory within the next few years.

Making Better Railroad Concrete

SPEAKING in general, the concrete in railroad structures in this country is of poor appearance. There are several good reasons for this. Most railway concrete is in exposed situations, retaining walls, bridge abutments and the like, where the full force of weather plays on large flat surfaces, a condition that promotes surface disintegration of concrete. All concrete structures of this sort, whether built for railways or not, are less sightly and nearer the end of useful life than are protected or interior concretes. But beyond this, railway concrete has suffered from the great evil of railway engineering, that is, a much over estimated self-sufficiency and a refusal to learn from other than railway engineers.

This indictment cannot be brought against the whole of the railway engineering profession, obviously. The work Cartlidge did nearly two decades ago on the Burlington and Ray on the Lackawanna more recently was ahead rather than behind the rest of the engineering world, but by and large the structural engineers on our railways even today do not know what has progressed in the art of making concrete, or if they do know are satisfied that the way they have always been making concrete is better than anything that can be taught them. There are some roads, notably the Big Four, the Jersey Central and now the Pennsylvania—the latter of which not so long ago had a chief engineer who boasted that he would never break up big stones into little ones so as to put them together again—which are introducing the new and more careful methods of concrete making and are producing structures of outstanding excellence of appearance. But too many of the railroads continue to resist the new knowledge of concrete. If they did this on the ground that this new knowledge promises nothing, there would be little opportunity to criticize, but unfortunately the opposition is too frequently mere inertia, mixed with the idea that the railroad engineer who has been putting in concrete for a generation can learn nothing from anyone in that particular specialty. The condition of most railroad concrete structures, as was said in the first sentence of this note, makes none too tenable this comfortable attitude.

Double-Tracking and Relocation on the Santa Fé Ry.

Continuous 723-Mile Stretch of Double Track Relieves Traffic Congestion—Line Revision and Grade Reduction—Heavy Rock Work—Concrete Revetment for Slopes

GENERAL improvement of the busy main line of the Atchison, Topeka & Santa Fé Ry. System for 723 miles between Albuquerque, N. M., and Barstow, Calif., by double tracking, curve reduction and reducing the maximum grade from 1.8 to 1.42 per cent was completed in 1924 by the closing up of six sections of the work. In general the new second track parallels the original track on a widened roadbed, but at several points it is on new location while at other points new double-track stretches are built and the old single-track line is abandoned. Typical views of the work are shown on p. 389. Fig. 2 is a general map and Figs. 3 and 4 include typical examples of the line revision and relocation.

Traffic congestion necessitated the double-tracking of this long stretch of line, which forms a link between several routes. Thus from Dalies, the junction point near Albuquerque, there are two main lines eastward which converge again at Kansas City, while a third line extends south to Galveston and a fourth to El Paso. West of Barstow, there are two main lines, one extending south to Los Angeles and the other north to San Francisco. Thus all traffic between east and west points and between Gulf and Pacific Coast points passes over the line between Dalies and Barstow. There are two operating divisions and at some points the grade reduction enabled the standard train loads to be increased. The traffic averages 46 trains daily; six passenger trains each way, 12 freight trains westbound and 22 eastbound, these last consisting largely of fruit shipments which require prompt movement. In addition, there are extra sections of passenger trains and the movement of light engines westbound to equalize the equipment. On the Los Angeles line, south of Barstow, an 82-mile continuous stretch of double track has been completed by the construction of a 43-mile link between Summit and Hicks which was put into service in 1924. These seven stretches with a total length of 329 miles and costing about $19,000,000 are as follows:

	Miles	Cost
Dalies to Rio Puerco	8.84	$500,500
Suwanee to McCartys	33.83	1,535,160
Horace to Baca	24.27	1,097,100
Perea to Defiance	23.38	1,058,660
Yampai to Topock	124.74	8,889,400
Bagdad to Daggett	65.00	3,336,970
Total	280.06	16,417,690
Hicks to Summit (on Los Angeles line)	49.14	2,618,210
Grand total	329.20	19,035,900

Yampai to Topock—On this 125-mile stretch, 88.4 miles of the new second track are alongside the original line, while 15.19 miles are on a diverging location and there are 23.26 miles of new double-track location with 11.78 miles of old line abandoned. Maximum grades were 1.8 per cent eastbound and 0.95 per cent westbound, but the former have been reduced to 1.42 per cent and the eastbound train rating increased from 1,600 tons to 1,950 tons. Curves of 8 and 10 deg. on the old line were reduced to a maximum of 4 deg., except for a 7½ deg. curve into Kingman and two of 8 deg. in the Crozier Canyon. The country is mountainous from Yampai to Hackberry, beyond which the line crosses the valley to Louise and enters the mountainous country along Kingman canyon; at Griffith it enters the desert and in general follows this to Topock. Summer temperatures range as high as 120 deg. F. at Topock, but some of the heavy steel bridge erection near Topock was done during the hottest weather in August.

Bagdad to Daggett—Radical reduction in curvature and the linking up with double-track at each end was the basis of improving this stretch, on which the length of single-track diversion for the new second track is 3¾ miles. On account of the grade limits westbound, there were two 10-deg. horseshoe curves to develop distance, but in the new second track construction it was possible to cut off some distance by constructing this diversion with a heavier descending grade

FIG. 1—FILL WITH CONCRETE SLOPE REVETMENT IN CROZIER CANYON

for the eastbound track. There are also about nine miles of new double track with ten miles of old single track abandoned due to relocation for curve reduction. A very crooked location with many 10-deg. curves was developed for the original line, but on the revised line the maximum curvature is 6 deg. The maximum eastbound grade is now 0.94 instead of 1 per cent, while the maximum westbound grade remains at 1.42 per cent. The standard train rating is 2,000 to 2,500 tons eastbound and 1,500 to 1,800 tons westbound, according to type of engine. The line lies largely in desert country. In summer the climate is very hot and there are heavy rains, this being what is known as "cloudburst" territory.

Between Dalies and Defiance—On this 90-mile stretch of line there were four separate sections for improvement, as noted in the table, linking up previous sections of double track. Here the new second track was built parallel with and adjacent to the old line, with no change in distance, grade or curvature. The maximum grades are 0.6 per cent eastbound and 0.22 per cent westbound, with 3 and 4 deg. as the maximum curvature. Standard train loads are 2,800 to 3,000 tons eastbound and 2,600 to 2,700 tons westbound. The country is generally

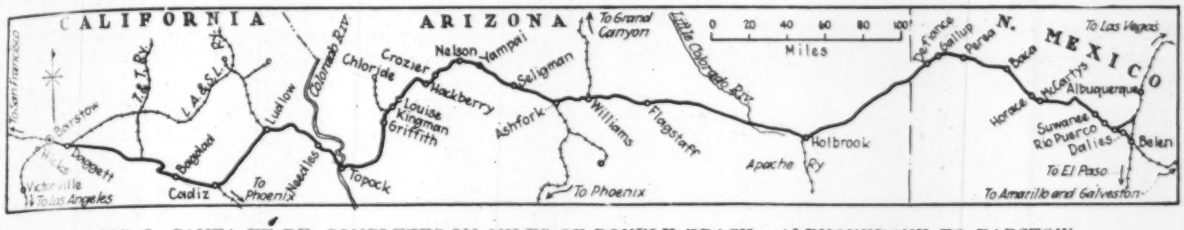


FIG. 2—SANTA FE RY. COMPLETES 723 MILES OF DOUBLE TRACK: ALBUQUERQUE TO BARSTOW

flat, with a long gentle slope toward the continental divide.

On the Los Angeles Line—Traffic averaging a train every 24 minutes during periods of heavy business has necessitated double tracking on a considerable part of the Los Angeles line, extending south from Barstow. Two existing lengths have been connected by a 43.75-mile link of double track between Hicks and Summit, which was completed in 1924, and makes a continuous stretch of 82 miles. The new link includes about 1.6 miles of new single-track diversion and nearly ten miles of new double-track diversion. There is no reduction in grade, but the maximum curvature is reduced from 10 deg. to 6 deg. The maximum grade eastbound is 0.7 per cent; westbound it is 0.57 per cent, except for a pusher grade of 1.64 per cent for 19.2 miles from Victorville to Summit. A combination of right-hand and left-hand running is an unusual feature. On the double track south from Barstow there is the usual right-hand running and this is continued for thirty miles on the new work; then an overhead or flyover crossing was introduced to give left-hand running into Summit, beyond which the present double track is operated left hand on account of grade conditions. Between Hicks and Summit the line is partly in mountainous country and partly in a desert and valley district.

Construction Work

Grading—A large proportion of the excavation was in rock, which was of three kinds: a lava formation known as "malapai" rock, requiring heavy blasting; limestone, requiring only light blasting, and granite which not only required heavy blasting but broke into such large blocks as to necessitate considerable bull-dozing. Widening of old single-track cuts, which was not extensive owing to the diversions, was done by station men, by fresno scrapers or by small steam shovels loading dump wagons; this last method was employed particularly in rock.

Fills were made with earth from side borrow-pits and with material hauled from cuts and detached borrow-pits. For the larger fills, dumping from temporary trestles built of framed bents was generally employed; some of those trestles were 40 ft. high. Low fills were built up from side borrow-pits by fresno scrapers and dragline excavators, or by dumping from small cars on a track which was raised with the fill. Steam shovel casting was employed for the bases of some long double-track fills, 28 and 24 ft. high. The shovel, on crawler traction, excavated a borrow-pit and cast the material toward the fill, leaving a 12-ft. berm outside the slope stakes. A second shovel followed on this berm and recast the material within the slope stakes, building the fill to full height; the top was then leveled and a narrow-gage construction track laid for widening the fill to full section by side dumping.

Rock excavation on the Los Angeles line (Hicks to Summit) was attended with difficulties. In some cuts after about 10 ft. of hard material a layer of sand was encountered which caved back with a steep slope so that the hard surface on top would overhang and break off. In other places a peculiar condition existed in that the granite was seamed throughout and massive boulders were discovered on slopes of 10 to 80 deg. Since in many cases the slopes were toward the track, it was necessary to exercise great care in blasting to prevent large quantities slipping onto the main line. In widening a rock cut 35 ft. deep on an 8-deg. curve the main track was lined over a few feet, and by means of station work and small steam shovels about 20,000 yd. of granite was taken out with practically no interference to main line traffic, except slowing the trains past the work.

Widening old fills by side dumping from trains on the main track was kept at a minimum. Where this method was necessary, the movement of both the contractor's trains and the regular trains was supervised closely by a construction trainmaster. In most cases, however, a parallel new fill was built by the methods described above.

Handling Construction Trains—As a rule the construction work was kept clear of the operated line. Where the contractor's work trains had to operate on the main line, the railroad furnished train crews and the contractor furnished cars, engines and engine crews. The railroad company charged the expense for train crews against the contractor; if the company had furnished engines it would have charged also a daily rental for these which would have been based on the tractive power.

At points where the work caused temporary interference with the main line (even if the latter was not used by work trains), as when a construction track was benched so as to foul the main track for a short distance, slow-order signs were placed, and the contractor was required to maintain flagmen. In heavy granite excavation along the main track on the Los Angeles line the contractors were required also to protect the track by a covering of old ties and timbers before blasting and to fire the blasts only at such times as would cause least delay to traffic. Trains were given orders to approach certain points under control and to proceed only upon signal.

Double-Track Tunnel—The only tunnel included in this work is a 413-ft. double-track rock tunnel between Nelson and Fields, just beyond Yampai (see Fig. 4). The tunnel is on a 4-deg. curve and is lined throughout with concrete. As the limestone formation has seams of earth, it was necessary to place timbering as fast as the excavation was finished to full section. Tunneling was started at both ends, with a center heading and two side headings. The bench was removed by an oil-fuel

steam shovel loading 16-yd. air-dump cars which were handled by locomotives. After the tunnel had been completed, the timbering was removed in 12-ft. lengths; as each length was cleared, forms for the lining were placed and an air-gun at one end of the tunnel shot concrete through a 6-in. pipe to the forms.

STRUCTURES

Bridges and Trestles—Steel bridges are mainly single- and double-track plate-girder deck and through spans of 70 to 100 ft., with I-beam spans for the smaller openings. On the Los Angeles line, however, there is a 200-ft. span over the Mojave River. Timber trestles, which are generally short and of no great height, are built of creosoted piles with ballasted decks of creosoted timber, according to the Santa Fé standard

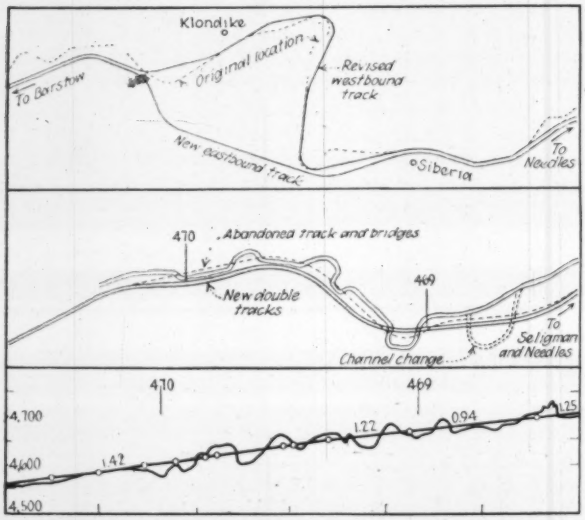


FIG. 3—LINE REVISION ON THE SANTA FE RY.
Above—Original line revised for westbound track and separate location made for new eastbound line. Below—Line and channel revision in Peach Springs Canyon eliminate eight bridges.

plans; those over highways have waterproofed decks. Concrete is used for piers and abutments and also for arched and slab-deck culverts. Except for the slab work, the concrete was made at the several sites by small portable mixer plants. An unusual concrete construction was a 30-ft. arch 192 ft. long, near Nelson, where the new and old fills approach at an angle and the old track is carried by a 42-ft. girder span. The arch was extended on a curve of 35-ft. radius from the new fill to the masonry of the old bridge.

Many waterway openings are required on the Bagdad-Daggett section, which is in "cloudburst" territory with heavy and rapid runoff. Most of the numerous concrete openings with low headroom have concrete slab decks 9 to 16 ft. long; others have ballasted timber decks. Concrete slabs were made in a yard at Ludlow; after curing for 21 days they were taken out by work trains and placed by a railway wrecking crane or a locomotive crane. To protect the fills from erosion by flood runoff, the upstream slopes are protected by concrete revetment, as described later. It was generally found that the slab work could not keep up with the other work, so that the openings were spanned temporarily by timber stringers. Since no sand or gravel was available within 175 miles haul, a rock crusher and screening plant was installed, producing crushed stone and sand from a wash or dry creek. This material was used for the concrete slope blanketing and for gravity concrete in low structures. Arches and reinforced concrete were made from sand and crushed stone hauled to the site.

Special erection methods were required where several old single-track bridges of 60 to 105½-ft. span had to be replaced by new double-track bridges without interrupting traffic. The structure for the new track was erected off center, with one side resting on the new abutment and the other on falsework, the structure being carried by rollers. Shoofly tracks then connected the old and new tracks with gantleted track on the new span to carry traffic. After the old bridge was removed, the new single-track span was jacked up, rolled laterally into position and lowered on to the abutments. The additional girders and framing for the other track were then placed, completing the structure. At the Mojave River, the two tracks were gantleted over the old 165-ft. span for about two months until the new 200-ft. single-track span had been erected. The additional length was in order to put the abutments on solid rock. Curved approaches facilitated the spreading of the tracks for the two spans, the distance center to center of tracks on the bridges being 22 ft.

Water Stations and Passing Sidings—Water stations 12 to 25 miles apart are supplied mainly from deep or shallow wells, but occasionally from springs. At one point water is brought in tank cars and discharged into a pit from which it is pumped to the elevated tank. Since no water is obtained on the Bagdad-Daggett section, the supply for the two water stations is hauled in tank car trains 30 to 50 miles from Newberry. These trains, which also served the construction work, form a part of the regular traffic. Passing sidings on the old line are largely incorporated in the new second track, but new passing sidings about 4,000 ft. long and averaging nine miles apart are provided for both the new main tracks. Set-out tracks 350 ft. long are provided at the same points. To further facilitate handling the heavy traffic trailing crossovers are provided at all stations.

Concrete Revetment—In the "cloudburst" country where dry creeks or washes may suddenly become raging torrents, it was necessary to protect the slopes of fills from erosion by means of a concrete blanket on the upstream side, especially near the numerous waterway openings. This blanket consists of a 6-in. layer of reinforced concrete of varying width according to height of protection needed; it extends usually from a concrete toe wall which has a 6x12-in. notch to receive it. After this wall had been poured, the embankment was dressed to the proper slope and reinforcing bars were placed, being held 2-in. from the surface of the slope by pieces of stone. Headers of 2x6-in. lumber were placed 8 ft. apart and alternate blocks were then poured; the intermediate blocks were poured on the following day, after removing the headers. For several days the blanket was sprinkled or flushed once or twice daily and then a light layer of loose earth was spread to keep the concrete from drying too rapidly. A portable plant was used, with a 7 to 9-ft. mixer traveling on top of the fill; from this plant the concrete was chuted into place.

At Crozier Canyon, where the concrete had to be built to a height of 28 ft. on a new earth fill about 35 ft. high (see Fig. 1), steps were taken to prevent the fill from settling away from the blanket and causing it to crack and collapse. For this purpose water was led by a 2-in. pipe from a pumping plant about 600 ft. distant. A length of hose on the end of the pipe carried a ½-in. jet pipe 14 ft. long which was thrust as deeply as possible into the fill at 5-ft. intervals. This treatment caused heavy settlement without side slipping. After about three weeks to allow settlement and drainage, the embankment was dressed and sloped by hand, and the concrete blanket was placed.

TRACKWORK

Track and Tracklaying—Experimental and test features are included in the new track, which consists of 90-lb. rails, laid to break joints, spliced with 24-in. angle bars and having 22 creosoted ties to each panel. Tieplates are used on all ties and twelve rail anchors to each panel. Ties of various kinds and with different treatments, laid usually in lots of 100 ties each, have copper tags bearing symbols to indicate the kind of wood and treatment. There are also rails of specially treated steel, two types of rail anchors, two kinds of nutlocks and several kinds of tieplates, including some canted tieplates. Accurate records were kept of the location of all these test materials so that their behavior may be noted. Sidings and spurs were constructed generally with second-hand 90-lb. rails on second-class treated ties with tieplates. For the contractor's construction tracks, the railway furnished second-hand ties and rails, the rails being usually of 50- and 56-lb. section. Ballast was handled by company forces. Automatic signals of the daylight lamp type were installed in connection with all this second-track work on the line.

Tracklaying followed close upon the grading and the usual expense of a material yard was practically eliminated by securing track materials as fast as the roadbed was completed. Thus the material could be delivered directly and unloaded on the new roadbed without the necessity of storage at yards. In laying the parallel second track, a gang of about 35 men with a foreman and accompanied by a work train on the old track, distributed the rails, ties, fastenings and other track material ahead of the tracklaying gang. This latter gang averaged 95 to 100 men with a general foreman, two foremen and two assistant foremen. A small rail-laying power crane traveling on the new track set the rails in place. Following came a gang of about 80 men ballasting and raising track on the first 7-in. lift of gravel ballast, which was delivered in center-dump hopper cars and leveled by a spreader car. After the track had been used by work trains for a time, so as to consolidate the ballast, a second lift of 5 in. was made to take out settlement and give the full 10-in. depth. A gang of 90 men followed to tamp and finish the track. After the new track had been in regular service for about a month, it was given its final surfacing, lining and dressing.

In planning the laying of track, for each piece of work proposed the Los Angeles office prepared a complete bill of material. As soon as authority to proceed was granted, complete delivery orders were placed with the store department by wire, a percentage of material being specified for delivery on a certain date. In general the engineering department was successful in anticipating the progress of the construction work, so that all track material could be delivered directly on the finished roadbed. Actual progress coincided closely with what had been planned.

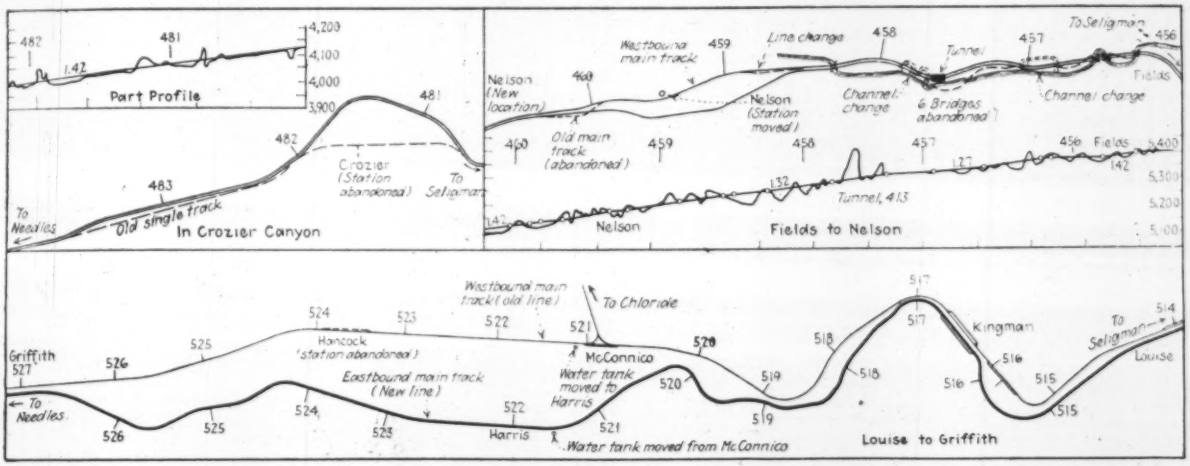


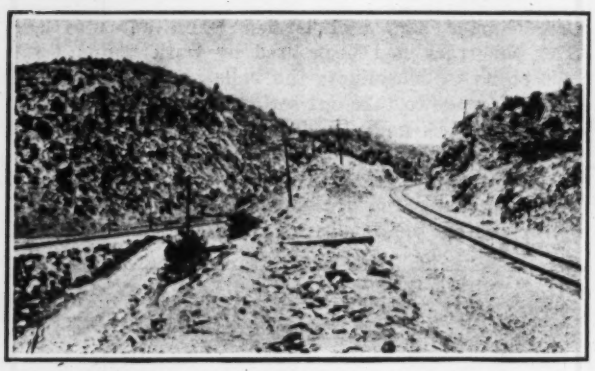
FIG. 4—TYPICAL LINE CHANGES AND DOUBLE-TRACK LAYOUTS

Since the new track was opened to traffic in short sections of six to fourteen miles, usually extending the double track to the next telegraph station, no delay or interference with tracklaying was permitted. If a bridge was not completed, the track was laid across or around the opening. In spite of heavy grading no less than 414 miles of ballasted track was completed in the periods from the end of February, 1922, to August, 1923, and from Feb. 15 to Dec. 31, 1924, no work being done in the 6½ months interval. This trackage includes new main line, and the sidings, spurs and line changes.

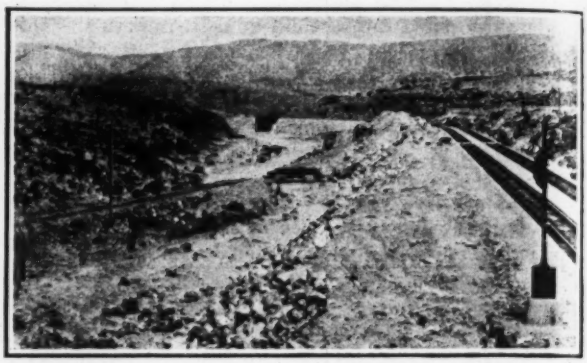
Most of the gravel ballast came from pits in the vicinity of the work and at one time the railroad had four large pits in operation. When ballast cars were difficult to obtain, these pits were worked at night instead of by day and only enough cars were retained

Views from Various Railroad Construction Projects

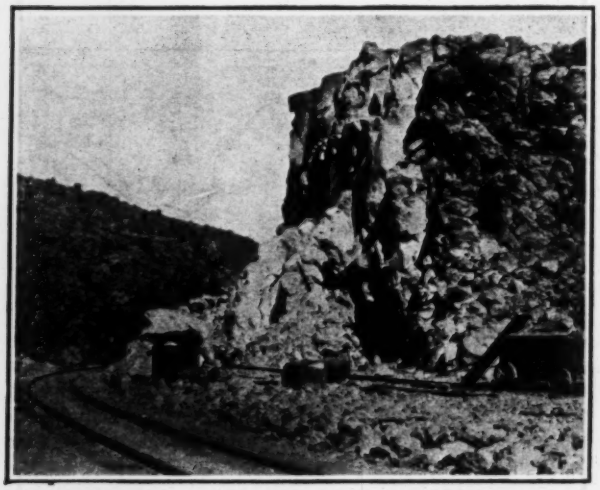
Double Tracking with Line and Grade Revision, New Line Construction, Suburban Rapid Transit Extensions, Tunnel Construction, Bridge Building, Railway Port Development, and New City Terminals



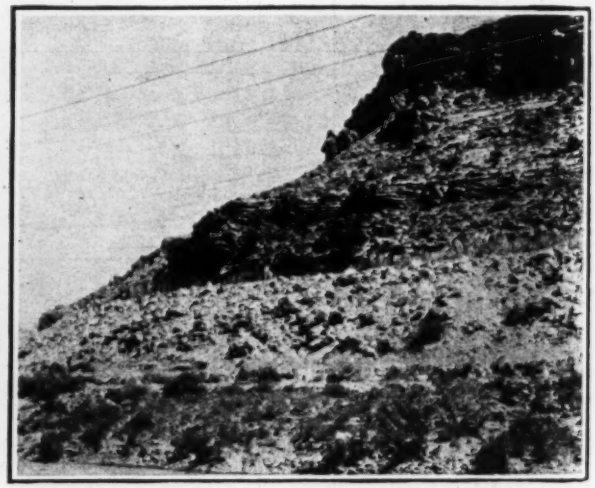
Nelson Canyon, Ariz., eastbound track on right; westbound track on left.



Peach Springs Canyon, Ariz., abandoned single-track line in valley on left.



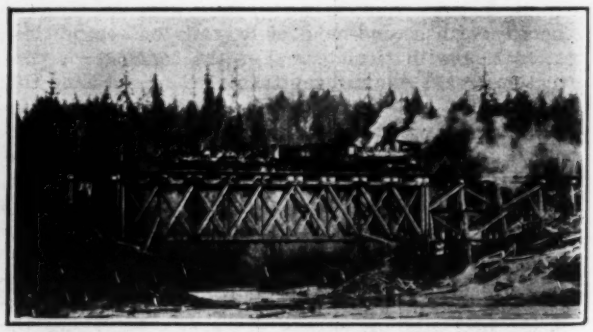
Crozier Canyon, Ariz., 50-ft. rock cut for second track.



Kingman, Ariz., completed cut for eastbound track.

Four Pictures of the Santa Fé Ry. Double-Tracking and Line Revision

Grading along Cowlitz River, Wash.

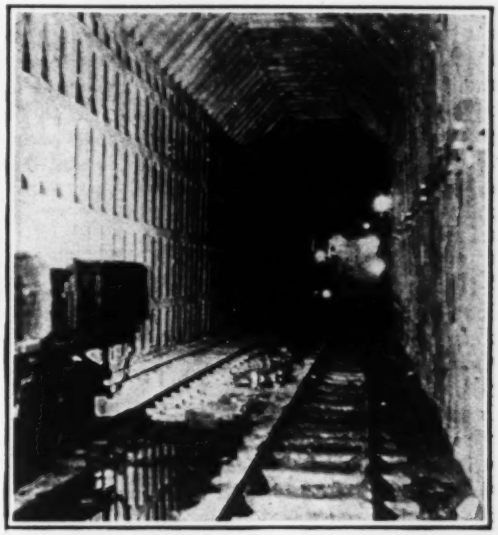


Timber truss over Stillwater Creek, Wash.

Longview, Portland & Oregon Ry.

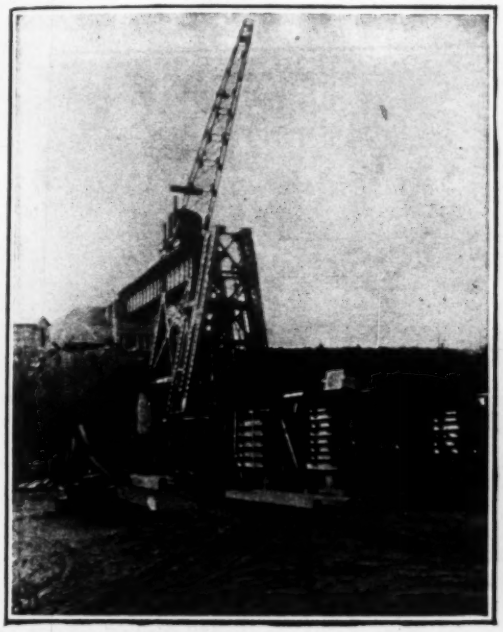
Making a high fill.

Chicago, North Shore & Northern Ry.



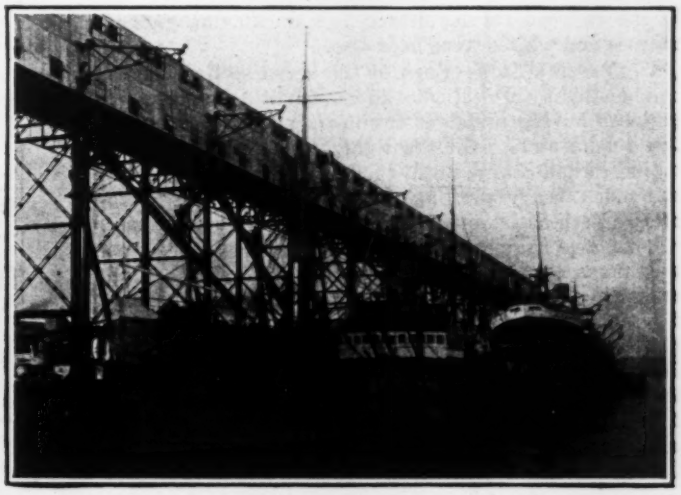
Moffat Tunnel

Timber lining in place.



Sugar Creek viaduct.

Chicago, Burlington & Quincy R.R.



Grain pier, Locust Point Terminals, Baltimore, Md.

Baltimore & Ohio R.R.

Excavation for new terminals. In the foreground land cleared of most of the buildings and excavation under way.

Cleveland Union Terminals.

for the one-shift loading. The loaded cars were taken out in the daytime and returned for night loading. In this way, it was possible to operate four pits with about the same number of cars that would have been operated in two pits with day loading. If the ballasting got behind the trackwork, the pit shovel was operated on double-shift, day and night. It is stated that this method of operation demonstrated that night loading was about as effective as day loading.

ENGINEERS AND CONTRACTORS

Contractors—For five of the seven stretches of double-tracking, aggregating 267 miles, the general contractor was the Sharp & Fellows Contracting Co., Los Angeles, Calif. The Suwanee and Horace sections, aggregating 58.50 miles, were let to the List & Gifford Construction Co., Kansas City, Mo. A large amount of both the grading and the masonry was sublet, the length of grading sections depending upon the amount of the sub-contractors' equipment. All steel bridge work, including erection, was done by the American Bridge Co. Mexican labor was used largely by the contractors and by the railroad for its bridge and tracklaying gangs; negroes and whites were used also.

Engineering Staff—Each of the seven sections noted was handled by a local office in charge of a construction engineer having assistant engineers and two construction roadmasters. On the lighter work the assistant engineers had charge of 25 to 30 miles; but when there was much heavy grading the lengths were 10 to 15 miles. Each assistant engineer had an instrument man, rodman, two chainmen and such masonry inspectors as were necessary. The construction engineer handled all accounting and payrolls, being provided with a construction accountant and the necessary office force.

All this construction and improvement work was under the direction of R. B. Ball, chief engineer of the A., T. & S. F. Ry. (Coast Lines), at Los Angeles, his office reporting to the general manager at Los Angeles and to G. W. Harris, assistant chief engineer of the A., T. & S. F. Ry. System at Chicago. L. G. Harris was construction engineer in charge successively on the Yampai-Topock, the Dalies-Rio Puerco, the Perea-Defiance, the Suwanee-McCartys and the Horace-Baca sections. R. Jones was construction engineer on the Bagdad-Daggett section and then on the Hicks-Summit section. Bridge design and erection were under the supervision of A. F. Robinson, bridge engineer, and all work was subject to the general direction of C. F. W. Felt, chief engineer of the Atchison, Topeka & Santa Fé Railway System.

Railroad Gross Revenue Less Than in 1923

The gross operating revenue of the Class I railroads, representing a mileage of 236,000 miles out of the total of about 250,000 in the United States, was $5,986,500,000 for the year 1924, a decrease of $373,900,000 as compared with 1923 according to reports filed with the Interstate Commerce Commission and compiled by the Bureau of Railway Economics. Despite this fact the net operating income of $987,100,000 was $3,400,000 in excess of the net operating income for 1923. This net income gives a rate return of 4.35 per cent on the property investment, a rate which varies from 3.12 per cent for the Northwest Region and 3.74 per cent in the New England Region to 6.03 per cent for the Pocahontas Region.

Rush Work on the Natron Cutoff, Central Pacific Ry.

Completing New Oregon-California Route—Heavy Mountain Work—Tunnel Sections—Camps and Winter Conditions

TO EXPEDITE the completion of the 108-mile Natron cutoff through the Cascade Range, between Kirk and Oakridge, Ore., and thus to enable its new route between Portland and San Francisco to be opened late in 1925, the Central Pacific Ry. is pushing the construction work, which includes heavy grading and numerous tunnels. At present about a thousand men are employed. Particulars of this new line were given in *Engineering News-Record*, Sept. 25, 1924, p. 504.

There will be nineteen tunnels, aggregating 19,681 ft., the longest being 3,648 ft.; all but two or three of the short ones have been started, and in December, 1924, seven tunnels were well under way. Starting the portal of a tunnel in snow covered country is shown in Fig. 1, and standard tunnel sections are shown in Figs. 2 and 3. On curves, the horizontal distance between center lines of tunnel and track is 2 in. for 1-deg. curves, increasing by 2 in. to 10 in. for 5-deg. curves. In tunnels which are partly on curve and partly on tangent, but with less than 200 ft. of tangent, the section for curved tunnel is used throughout. Where this length is more than 200 ft., the widening of the curved section is made in a length of 50 ft. on the tangents. For the timbering of tunnels, usually of redwood or cedar, the bents are spaced 4 ft. or more between centers. Where the nature of the ground necessitates a closer spacing, the lagging is made of such length that the intermediate bents may be removed before concreting. For the timbered and concreted tunnels, the quantities in cubic yards per linear foot are as follows:

FIG. 1—STARTING PORTAL OF TUNNEL 5

	—Timbered—		—Concreted—	
	Sec. *A*	Sec. *B*	Sec. *A*	Sec. *B*
Excavation	18.45*	19.29*	20.00	20.810
Excavation for invert	.....	.....	0.270	0.290
Concrete lining	.....	.....	5.090	5.136
Concrete invert	.....	.....	0.294	0.314

*Excavation above profile grade and 6 in. outside of the 10x14-in. timbers.

On the western slope, where the heavy work is concentrated, the right-of-way had to be cleared through

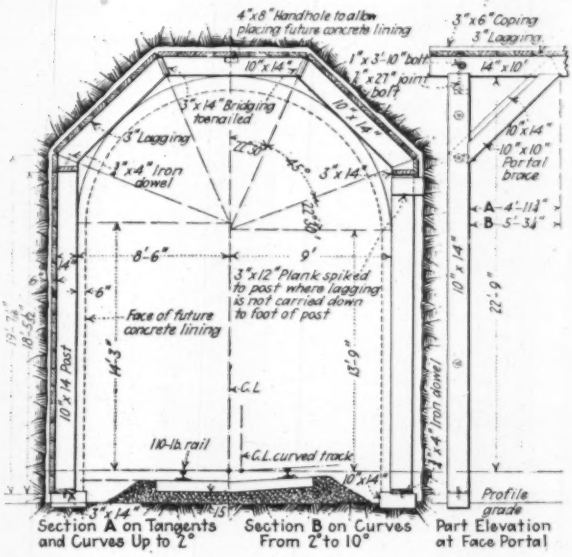


FIG. 2—TIMBERED TUNNEL SECTION

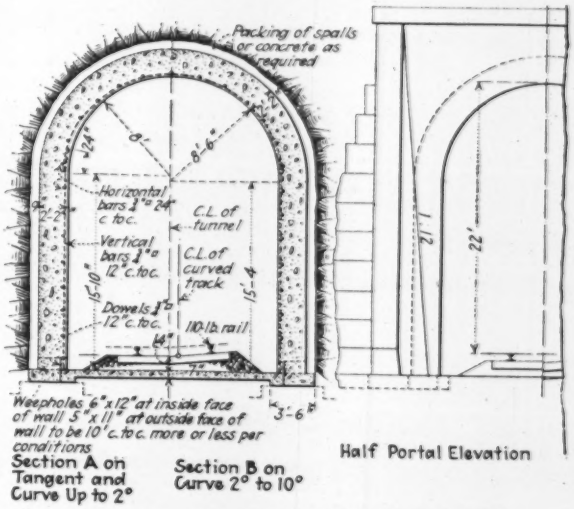

Packing of spalls or concrete as required
Horizontal bars 1" ø 24" c. to c.
Vertical bars 1" ø 12" c. to c.
Dowels 1" ø 12" c. to c.
C.L. of tunnel
C.L. of curved track
110-lb. rail
Weepholes 6"x12" at inside face of wall 5"x11" at outside face of wall to be 10' c. to c. more or less per conditions
Section A on Tangent and Curve Up to 2°
Section B on Curve 2° to 10°
Half Portal Elevation

FIG. 3—TUNNEL WITH CONCRETE LINING

forest land so densely timbered that a vast amount of merchantable timber was cut on the first 27 miles east of Oakridge. Part of this clearing is shown in Fig. 4. From Oakridge, El. 1,200, there is a steady climb of 3,681 ft. to the summit at El. 4,881, a distance of 42 miles. To maintain a maximum grade of 1.8 per cent, compensated for curvature, with a maximum curvature of 8 deg., Salt Creek is spanned by a viaduct 70 ft. high and 515 ft. in length, on a 6-deg. curve. There will be four steel viaducts, in addition to several arches and culverts.

The eighteen miles of wagon road which had to be built before supplies could be taken to camps near the summit are now a most important factor, for should they be blocked, the hundreds of workmen in the canyon and on the slope of Cougar mountain would be cut off from communication. The road to the high line climbs 1,400 ft. in four miles on a grade of 8 per cent. For the first camps it was simply a pack train route, but the road builders followed close behind the packers. Before the wet weather set in these roads were put in condition by special gangs which also prepared corduroy and planking for the muddy places.

There are nine tunnel camps in convenient spots between tunnel 2 and tunnel 15. Winter camps are smaller than those used by the loggers, the largest housing only 85 men. They are made up of substantial wooden buildings, well heated with stoves and supplied with bath houses and lounging quarters for the men. Practically all the supplies, except perishables, such as meat and fresh vegetables, were taken in last August and September. All stores were protected in frost-proof buildings made with double walls and packed with moss or sawdust, proper ventilation being provided to prevent damage by low temperature. Great care had to be taken with cement, as the buildings for storing it were relatively small. It was sent up to the camps in quantities calculated for use within thirty days and was stored in wooden buildings equipped with stoves to prevent hydration.

Snow beginning about Dec. 1 covered the ground above El. 3,000 ft. and at tunnel 15 it reached a depth of nearly two feet. At various times it went up to 4 ft. at this point and to 6 ft. on the summit, while the depth often reaches 12 ft. at this point in winter. Trails between camps and tunnels are kept open, shovel crews going out after each snowstorm. Hauling is done as far as the snow line by means of crawler tractors; beyond this point heavy horse-drawn sleds are used.

FIG. 4—CLEARING RIGHT-OF-WAY THROUGH HEAVY TIMBER

The greatest difficulty involved in tackling winter work was overcome when equipment and supplies had been taken in. Most of the men work underground and weather conditions do not trouble them so long as they can get from the camps to their work. Even steam shovel operations can be continued where the material is rock, except when a blizzard is brewing. One of the difficulties of grading is that in the construction of fills no large amount of snow can be permitted to lie between successive layers of material. If work on a fill has been stopped during a heavy snowstorm, the exposed portion of the fill must be cleared before dumping is renewed. This shoveling entails considerable extra labor and it has been frequently necessary, on account of economy, to tie up operations under such circumstances. However, eleven steam shovels have been kept busy most of the time.

Although the main part of the supplies is stored, some hauling is carried on in winter, especially on the upper line where tunnel timbers are being brought from a small sawmill established on Cougar Ridge. This mill is operating continuously throughout the winter, turning out about 25,000 ft. of lumber daily. If necessary this output can be increased by operating a double shift. Another portable mill is at Diamond Creek and a large mill at Odell Lake supply timber for work on the east slope.

This new line is being built under the direction of George W. Boschke, chief engineer of the Southern Pacific Company.

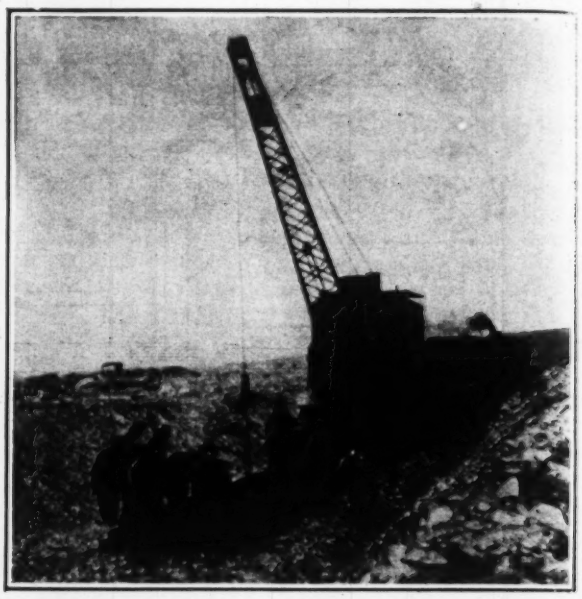


FIG. 1—TRACKLAYING ON UNION PACIFIC EXTENSION
Revolving crane takes rails and ties from rear cars and places them on subgrade.

Union Pacific Builds 95-Mile Idaho-Nevada Line

Idaho Irrigation Districts to Have Short Route to San Francisco—Pusher Grades Over Pequop Range

TO PROVIDE a short direct rail route between Idaho points and San Francisco, as an outlet for the products of large irrigation districts in southern Idaho, the Oregon Short Line R.R. (Union Pacific System) is extending its Rogerson branch 94.27 miles south from Rogerson, Idaho, to a connection with both the Southern Pacific Ry. and Western Pacific Ry. at Wells, Nev. This will give a distance of about 730 miles from Twin Falls to San Francisco, while at present, the distance by way of Ogden is about 973 miles. From Pocatello, the distances are about 800 and 914 miles respectively.

On irrigation projects west of the main line at Minidoka, the tonnage of agricultural products and livestock has reached a considerable figure. Seven irrigation districts have united in forming the American Falls District, which has financed the construction of a storage reservoir of 1,700,000 acre-feet to furnish water for additional land and also to provide storage to supply water during the dry years which occur at intervals.

Leaving Rogerson, El. 4,922, the line begins the ascent of the Shoshone Mountains, which it crosses in 18 miles at Shoshone Summit, El. 5,549. In the next eight miles it drops down to the valley of the Salmon River and follows up the river for about forty miles, then crossing a low divide at Willow Springs, El. 5,952, skirting the drainage area of the Great Salt Lake basin. After crossing this valley, the line ascends a spur on the Pequop Mountains, which it crosses in the Summer Camp Pass, about 21 miles north of Wells, at El. 6,443. After another small summit at Town Creek, the line descends to Wells, El. 5,621, in the drainage area of the Humboldt River, which the Southern Pacific follows for about 350 miles westward. Going south from Rogerson the total rise is 2,211 ft. and total fall 1,512 ft. The maximum grade is 2 per cent for six miles on each side of the Pequop summit, which may be operated as a helper or pusher district. The sharpest curves are of 8 deg., with a total curvature of 3,318 deg., or 35 deg. per mile; there are ninety-six curves in all, aggregating 25 miles in length.

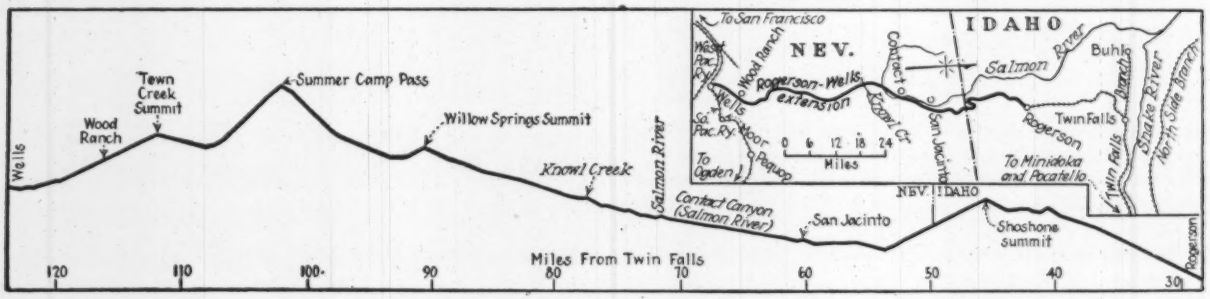


FIG. 2—ROGERSON-WELLS EXTENSION; UNION PACIFIC RAILWAY

This new line is being built on branch line standards and laid with second-hand 90-lb. rail. Grading amounts to about 2,750,000 cu.yd. The bridges are pile or frame trestles and only amount to an average of 32 lin.-ft. per mile. Culverts are of corrugated iron. Small frame stations are built and water stations have 50,000-gal. redwood tanks on wooden towers.

The work is progressing nicely; about 81 miles of line are graded and tracklaying is in progress from Rogerson, about 23 miles of track having been laid

to the end of January. Heavy rock cuts on the north end have delayed tracklaying until grading on the greater portion of the mileage has been completed.

A large portion of the line is through a semi-arid country used only for grazing and the entire distance through the narrow valley of the Salmon River is comprised in one cattle ranch. On this ranch there are many miles of meadow lands which are flooded or irrigated in time of high water by taking water from the river and spreading it over the land. The grasses of these meadows are later cut for hay. About forty miles south of Rogerson is the old mining camp of Contact, in the Salmon River canyon. Mining men have predicted that a large tonnage of copper ore which cannot stand cost of transportation by truck may be developed when railroad transportation is available. Development work in the mines has been extensive and during the World War some ore was hauled by truck to the railroad at Rogerson.

Grading is being done by the Utah Construction Co., Odgen, Utah. Bridge work and tracklaying are being done by railroad company forces. All work is under the direction of W. R. Armstrong, assistant chief engineer, at Salt Lake City. J. P. Elliott is assistant engineer in charge of construction, with office at Rogerson, Idaho.

Erosion Extends Relief Channel .. Far Beyond Its Bounds

Small Channel Through Silt Loam Deeply Cut in Short Time—Bridges Washed Out and Buildings Endangered

By C. E. Ramser
Drainage Engineer, U. S. Bureau of Public Roads, Cape Girardeau, Mo.

HOW UNEXPECTED results may complicate what, at first glance, appears to be a simple operation, is well illustrated in the results of the construction of the Cape La Croix Creek cutoff channel.

Cape La Croix Creek drains an area of about 20 square miles in Cape Girardeau County, Mo. Its watershed above the tracks of the St. Louis-San Francisco Ry. is typical of the upland areas in southeastern Missouri. It is comparatively hilly, the hilly portion

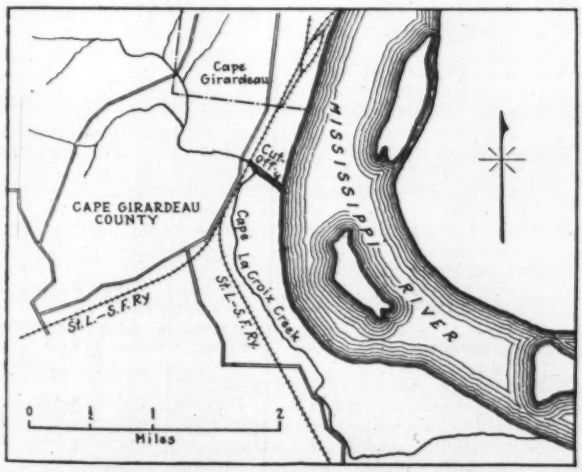


FIG. 1—MAP SHOWING RELATION OF CUTOFF TO LOWER PORTION OF CAPE LA CROIX CREEK

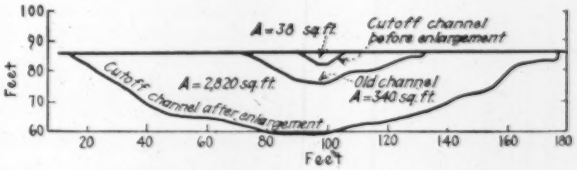


FIG. 2—CROSS-SECTIONS OF CAPE LA CROIX CREEK SHOWING AREA AND SHAPE OF CHANNELS

of the watershed lying about 200 ft. above the low flat land along the Mississippi River. Nearly all of the watershed is cleared and in cultivation. The hilly topography and the absence of forest cover are largely responsible for the high rates of runoff that occur for heavy rates of rainfall of comparatively short duration. The channel in the hilly portion of the watershed

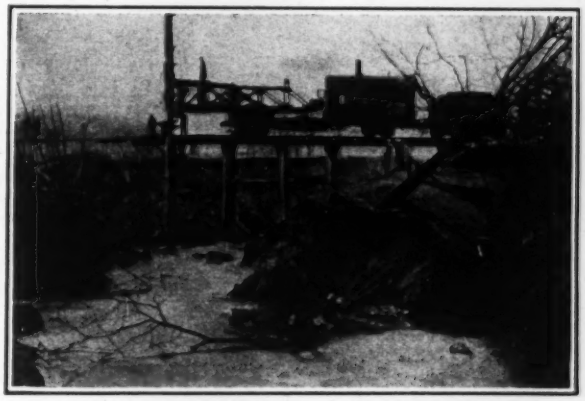


FIG. 3—CAPE LA CROIX CUTOFF CHANNEL
Looking toward the Mississippi River from the railroad trestle

has a large fall and delivers the water at the Frisco Ry. crossing faster than the old channel below the tracks can remove it. This portion of the channel has very little fall and is quite crooked. Overflows of the banks which have occurred after every heavy rain have caused damage to crops along this portion of the channel and especially to a small settlement known as Smelterville just above the railroad. In order to remedy this condition a cutoff channel was dug to the Mississippi at a point a short distance below where the creek flows under the Frisco Ry. tracks.

This cutoff channel furnishes a direct outlet to the Mississippi River, its length being about one-fourth mile as compared with a distance of 4½ miles which the water formerly traveled before reaching the Mississippi. As originally dug, the channel was about 4 ft. deep, 4 ft. wide on the bottom and 16 ft. wide on top. It was intended that it should carry only a portion of the water of Cape La Croix Creek since the bed of the creek was several feet deeper than the bed of this channel (see Fig. 2). Where the cutoff channel entered the river there was a sheer drop of 18 ft. between the bottom of the channel and the normal stage of the river.

The soil adjacent to the river at this point is designated by the Bureau of Soils as Waverly silt loam and that through which Cape La Croix Creek passes is called Lintonia silt loam. Waverly silt loam is described as follows: "The Waverly silt loam is a loose friable soil of excellent tilth. It is composed of uniform-sized silt particles which prevent the soil from running together and at the same time insure the best capillary

action of the soil water." The mechanical analysis of this soil shows that the surface soil contains 80.3 per cent of silt and the subsoil 74.1 per cent of silt. Sand occurs at a depth of about 15 ft.

Lintonia silt loam contains a high percentage of organic matter and the texture of the silt particles is coarse. It is mainly colluvial in origin, representing reworked material of the Knox silt loam.

Naturally erosion of the waterfall type began immediately at the mouth of the channel and proceeded rapidly upstream. A near-by resident stated that during the first heavy rain after the construction of the cutoff the waterfall moved 50 ft. upstream. In about 18

FIG. 4—LOOKING DOWNSTREAM PAST WASHED-OUT RAILROAD

months it had eaten its way back to the diversion point of the old channel, a distance of about one-fourth mile and six months later it extended back and undermined the Frisco Ry. girder bridge. The undermining of the railroad bridge which caused a suspension of traffic was due to a rain of about 3 in. which fell in about 20 hours on Jan. 20, 1923. This bridge was replaced with a pile trestle and traffic was resumed. About one week later a rainfall of 2.2 in. fell in about 24 hours and the trestle was washed out and traffic again suspended. In Fig. 3 is shown a view of the enlarged cutoff channel looking from the railroad bridge towards the river and in Fig. 2 is shown a cross-section of the cutoff channel before and after its enlargement.

During the two-year period this channel was enlarged by erosion from a cross-sectional area of about 38 sq.ft. to an area of 2,820 sq.ft. or about 75 times its original size. The depth increased from about 4 to 26 ft. and the top width from 16 ft. to about 160 ft. In addition to the damage to the railroad bridge, houses on the banks of the cutoff are endangered (see Fig. 3) and valuable agricultural land has been washed away. In Fig. 4 is shown a view of a pile driver replacing the trestle that was washed out.

While there is no question about the cutoff fulfilling its purpose, the extent of the damage resulting from its construction was certainly not anticipated.

Canadian National Ry. Extensions in 1924

During the year 1924 the Canadian National Ry. carried out considerable new track construction in spite of the delay occasioned by the refusal of the Senate to approve certain lines. Track was laid on 115 miles of new lines and grading contracts were let for 287 additional miles.

Tracklaying on Kentucky Line of Illinois Central R.R.

Advance 4,000 Ft. Per Day—Pioneer Car with Hand Derrick Handles Rails—Pneumatic Wrenches for Track Bolts

IN MOST of the railway construction of present days, with heavy track and through more or less settled country, the tracklaying conditions and equipment differ materially from those of earlier days when speed of advance on pioneer lines of relatively light construction was one of the principal considerations. An example of modern methods is the track-laying on the new single-track cutoff of the Illinois Central R.R. between Dawson Springs and Central City, Ky. This cutoff will give practically a double-track route, although the old and new lines are about ten miles apart. On the old line there are maximum grades of 1.4 per cent, with numerous curves, but the new line has a maximum grade of 0.5 per cent, and its comparatively few curves do not exceed 2 deg.

Tracklaying material was located along the Kentucky Midland Ry., an 8-mile line which forms the first part of the cutoff, from Central City to Midland. Two complete trains were used, one laying track while the other was loading material. Each train consisted of a pioneer car or tracklaying machine, two cars of ties, two cars of rails and one car with spikes, bolts, nutlocks, splice bars and tieplates. Behind the engine and caboose were three cars of ties for full tieing. The pioneer car, commonly called a tracklaying machine, was built at the railroad shops and consisted of a flat car having at the forward end a hand-power derrick and on each side a demountable trough or chute with rollers. Similar troughs were fastened on both sides of the rail and tie cars, men on the cars pushing the ties and rails along on the rollers.

At the head of the train were 60 men laying six ties to the rail length, fastening the splices with two bolts ahead of the pioneer car and bolting behind the car. The nuts were put on the track bolts with compressed-air wrenches connected to the train line of the air brake system. No spikes were driven ahead of the pioneer

TRACKLAYING ORGANIZATION: ILLINOIS CENTRAL R.R.

A. Men with Tracklaying Train

1 Foreman
1 Man on pioneer car handling derrick.
2 Men on pioneer car unloading material.
3 Men throwing ties by hand into roller runway on left-hand side of tie car.
5 Men carrying bridle rods ahead.
2 Men throwing rails into roller runway on right-hand side of rail car.
6 Men pushing rail and ties in runways.
2 Men lining ties.
2 Men distributing splice bars, bolts and spikes.
18 Men receiving and placing ties (three men carry each tie).
6 Men receiving and placing rails.
1 Man setting track gage and placing expansion shims.
2 Men on air machine, one ahead and one behind.
4 Men unloading ties behind caboose.
2 Men putting on splices before placing rail.
3 Men unloading tieplates and spikes.

B. Back Gang Behind Tracklaying Train

Foreman and 50 men jacking up track, putting ties under and spacing them.

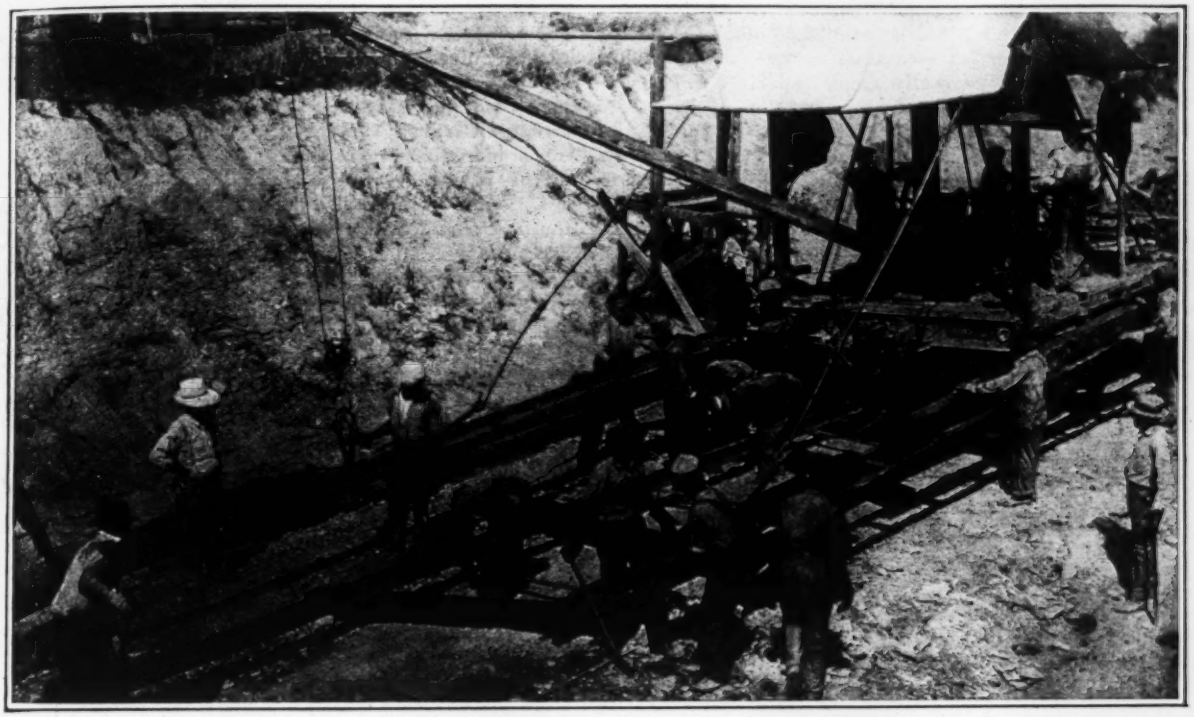
Foreman and 50 men tieplating, spiking and bolting.

car, the rails being held by bridle rods, which were taken off and carried ahead after the train had advanced. This force also unloaded ties from the three cars at the rear of the train. With this train and force the regular advance was 4,000 ft. of track in an 8-hour day.

Ties were delivered 16½ ft. ahead of the pioneer car by a chute or runway, each tie being then carried ahead by three men and placed in position on the roadbed, with one end lined against a cord. Other men adjusted the spacing of the ties by means of a measuring stick. The 90-lb. 33-ft. rails were delivered 16½ ft. ahead of the car by the roller chutes, each rail being then handled and laid by the derrick and six men. The line rail was laid to a chalk line on the rails; then the gage rail was placed and both rails were secured by the bridle rods, which were punched so that a spike could be inserted on the inner side of the rail. Meanwhile the heel joints were spliced with angle bars and two bolts. Since the curves were light it was not necessary to carry bent rails for the curved track.

Behind the train followed a gang of 50 men placing the full number of ties and directly behind them another gang of 50 men to place tieplates, spike the rails and complete the bolting of splices. A gang of 40 men in the rear installed switches and laid passing tracks; this gang was accompanied by a train which also carried materials for the fencing gangs. Another gang of 40 men loaded the idle train with material. The distribution of force is given in the accompanying table.

Ballast was not unloaded directly behind the tracklaying, but followed at a distance of several miles, so as not to interfere with the train loading material or the train serving the gang which installed switches and laid passing tracks. Gravel ballast, hauled in open-end cars and unloaded by a rapid-unloader, was applied in two lifts, a first raise of 9 in. and a final raise of 3 in. with lining and surfacing. For this work the track was raised with jacks by the ballasting gang.



HEAD OF TRACKLAYING TRAIN; ILLINOIS CENTRAL R.R.

At the left the derrick is picking up a rail delivered in a runway, and four men are adjusting a rail on the ties. At the right, ties are coming down a runway chute suspended ahead of the car, to be picked up and carried forward by men. The cord in the foreground is for lining the ends of the ties.

This new line was built under the direction of F. L. Thompson, chief engineer (now vice-president), Illinois Central R.R.; and E. L. Crugar, engineer of construction.

Time Limit for New Railroad Extended

The time limit has been extended by one and three years, respectively, for commencing and completing the construction of the proposed railway line of the American Niagara Bridge Co. across the Niagara River at Grand Island. The new line is a project to be undertaken jointly by the New York Central and the Canadian Pacific for the construction of a new connection between the Michigan Central Lines near Welland, Ont., and the New York Central lines near North Tonawanda, N. Y., by means of a double-track line across the Niagara River and Grand Island, including a classification yard on the island. The total length is to be about 20 miles. Two companies were organized some time ago to undertake the construction on opposite sides of the international boundary, the Canadian Niagara Bridge Co. in Canada and the American Niagara Bridge Co. in the United States.

Reconstruction of Front Street in Portland, Oregon

Relocated Railroad Spurs and Thick Concrete Paving 80 Ft. Wide Greatly Improve Traffic Facilities on Waterfront

THE IMPROVEMENT of a section of Front St. along the waterfront in Portland, Ore., which is now nearing completion, has required the co-ordination of many interests but has accomplished much in making waterfront properties accessible as well as in helping traffic conditions generally along the river. The improvement consists of the reconstruction of Front St. for a distance of 1¼ miles north from Glisan St. and includes the relocation of all tracks and public utilities involved and the laying of a reinforced-concrete pavement, 10 in. or more in thickness and 80 ft. wide.

Front St., as originally laid out, followed the top of the river bank along the edge of the Willamette River, the original ground surface being from 5 to 25 ft. below the present established grade. In the early days of the city's growth, this street area became a common dumping ground for sawmills and other industries located on the river front—sawdust, ship ballast and refuse of all kinds being deposited there. This kind of refuse filling has been constantly settling, causing depressions and uneven movements in the surfaces of the old stone block and granitoid improvements.

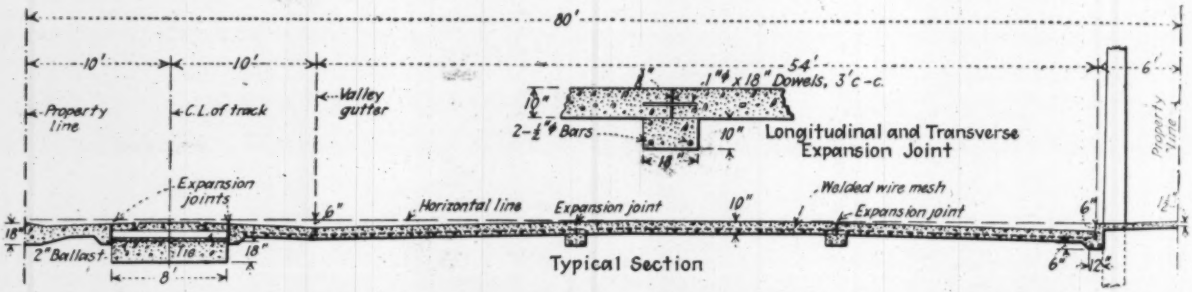
For years the traffic problem along this street has been getting more complex. As new wharf and docking facilities were developed, new spur tracks were run in from the railroad lines until a complicated network of sidings had been built; sewers as well as water and gas mains had been put in without reference to any definite plan and along most of this street the pavement had been worn and broken by very heavy truck traffic.

The reconstruction project places primary importance on a substantial paving job suitable for the heaviest trucking operations but another almost equally important feature is that it takes off all unnecessary or duplicated trackage and substitutes one good track on one side of the street with spurs wherever required. This change has been greatly facilitated by the fact that in recent years all switching along the waterfront and in the passenger terminal adjoining had been taken over by the Northern Pacific Terminal Co. which serves the several railroad companies alike.

The first step in the reconstruction program was to place the surface drainage and underground utilities, such as sewers, gas and water mains, in good condition and in the proper location. Poles carrying overhead wires were moved by the utilities affected to the sidewalk area and the water department moved the hydrants. The arrangement with the terminal railroad company was that all ties and rails would be taken up and new track laid by the company at its own expense.

In planning a pavement that would meet the traffic requirements at this location, specifications were drawn calling for a concrete slab with a minimum thickness of 10 in. Where old pavement was already in place but more than 12 in. below the finished grade, specifications required that a fill of crushed rock or river ballast be made to within 10 in. of finished grade or that the fill be made of concrete. The result is that due to the irregularities in the base the concrete pavement in many places is 14 in. thick.

The pavement consists of a 1:2:3 mix with ½-in. electrically welded wire mesh reinforcement, laid on the first pour of concrete which is spread to a thickness of not less than 2 in. Transverse expansion joints were put every 20 ft. and two longitudinal joints down the center are 16 ft. apart. Steel dowels dipped in asphalt are used in all expansion joints and on fills 18-in. slabs were placed below all such joints.



NEW ARRANGEMENT OF FRONT ST., WITH SINGLE TRACK AT ONE SIDE OF STREET

A particularly heavy construction was used in the railroad tracks. This consisted of an 18-in. slab beneath the track for the full length of the tie, flanked by expansion joints on either side separating the track construction from the inverted curbs of the adjoining pavement, or by ballasting the track with 24 in. of crushed rock and planking the tracks. Steel plates were then securely fastened to the planks by lag screws.

The Front St. improvement project was designed and constructed under the direction of O. Laurgaard; the Parker-Schram Co. was the contractor.

Some Appropriations of Interest to Engineers

Among the appropriations carried in the Agricultural Department bill recently passed by the United States Senate were the following: Bureau of Plant Industry, $3,881,073; Forest Service, $8,193,915; Bureau of Chemistry, $1,502,188; Bureau of Soils, $403,860; Bureau of Public Roads, $484,964; Bureau of Agricultural Economics, $4,738,056; Federal Horticultural Board, $756,110; Federal Aid Highways, $76,000,000; Bureau of Animal Industry, $5,839,645; Weather Bureau, $402,025; Experiment Stations, extension service, etc., $6,727,047. The total made available to the Department for use during the fiscal year beginning July 1, 1925, is $124,774,441.

Progress Toward Railroad Consolidation

An Outline of What the Railroads Have Done Voluntarily Towards Consolidation and a Comparison of Their Plans with Those of the Interstate Commerce Commission

THE GROUPING of the railroads of the country into a limited number of large competitive systems, as provided for in the Transportation Act of 1920, is not moving forward along the lines that it was anticipated it would at the time the act was written. Nor are all the systems that are being built up following the groupings laid down in the tentative plan prepared by the Interstate Commerce Commission. Instead, some railroads are working out their own groupings, apparently hoping that the future plans of the commission will be modified to suit actual conditions rather than to suit any theory as to what is the best arrangement of the new systems.

How the new groupings (they are not consolidations as defined by the Transportation Act) that have already taken place or are in the process of formation are being brought about, how they fit in with the commission's plans and with the plan prepared for it by Professor Ripley, will be outlined in this article. The present situation in regard to the Interstate Commerce Commission's plans for consolidation is that although the tentative plan was published in August, 1921, and some hearings have been held since there is no indication that the so-called final plan, the general consolidation plan, is to be published in the near future. This latter plan is not to be, necessarily, a final one as is so commonly supposed because the law provides that the commission may modify it from time to time. However, it is generally conceded that once the plan has been published it will be a difficult matter to obtain such modifications except in respect to minor details.

No actual consolidations may be made until after the commission's general consolidation plan has been published, and at the time the tentative plan was announced it was anticipated that little grouping of railroads preparatory to consolidation would be undertaken until this general plan appeared. But as time went by and no plan was forthcoming, and as the railroads got back to more normal conditions and commenced to look about for means of improving their condition there began to be rumors that a number of new systems were in the process of formation. The first one to take definite shape—and the most spectacular—was the new Nickel Plate System. It was followed in a short time by the expansion of the Southern Pacific, and later by the plans for the enlarged Missouri Pacific. Since then there have been rumors of still other groupings, and at the present time railroad men in the East are trying to settle their differences over the "Four System Plan" for the territory between Chicago and the North Atlantic ports.

The Transportation Act has been interpreted as providing three ways by which such systems can be built up pending the publication of the Interstate Commerce Commission's general plan: by lease, by stock ownership, or by the organization of a holding company and the exchange of the stock of this new company for that of the companies forming the new group.

The Interstate Commerce Commission is not unanimously agreed upon this interpretation of the act, but so far, in cases in which it has been called upon to approve of such changes in control, it has approved of them by a small majority. In giving its approval the commission has stipulated that it reserves the right to dissolve the combination at some later date if it does not agree with its general consolidation plan.

New Railroad Systems—Up to the present time the following railroad systems are the principal ones that have definitely taken shape or are known to be in the process of formation.

Missouri Pacific—The new Missouri Pacific System, although not so spectacular as the Nickel Plate System in the way it has been formed, is considerably larger and is a fine example of what may be accomplished by such consolidations as are outlined in the Transportation Act when properly managed. The system now includes the Missouri Pacific, 7,362 miles; the Texas & Pacific, 1,953 miles; the New Orleans, Texas & Mexico (Gulf Coast Line), 1,173 miles; the International-Great Northern, 1,159 miles; and the Houston & Brazos Valley, 43 miles, a total of 11,690 miles. In addition, the Missouri Pacific acquired a half interest in the Denver & Rio Grande in its recent reorganization.

The new system was built up, in large part, by obtaining control through stock ownership. The Gulf Coast Line acquired the International-Great Northern in June of last year and later on in the year the Missouri Pacific bought sufficient stock of the former to control both roads.

This grouping agrees with the Interstate Commerce Commission's tentative plan, which makes the lines now included in the Missouri Pacific System part of a much larger system extending to Chicago over the Chicago & Eastern Illinois. The arrangement agrees also, in a general way, with the Ripley plan, although the latter plan dismembers some of the railroads now in the grouping and assigns parts of them to other systems.

Nickel Plate—The new Nickel Plate System, including as it does a number of strong railroads, has been built up on a somewhat different basis. The nucleus of the present system was formed some years ago when the Van Sweringens of Cleveland bought the New York, Chicago & St. Louis R.R. (the Nickel Plate), 523 miles, and the Lake Erie & Western, 719 miles. This was followed at a later date by their purchase of the 454-mile line of the Toledo, St. Louis & Western. The grouping of these railroads into one system was approved by the Interstate Commerce Commission in 1923. Early in 1924 there were rumors of further expansions and in August it was definitely announced that plans were under way to combine the Chesapeake & Ohio (including the Hocking Valley), 2,905 miles, the Erie, 2,716 miles, and the Pere Marquette, 2,263 miles, with the roads already combined in the Nickel Plate System, making a total mileage of 9,680.

For the purpose of bringing about this grouping a new company has been organized and its capital stock is to be exchanged for that of the merged companies. This method has advantages over acquiring control of railroads by stock ownership, but as it approaches much nearer to actual consolidation and makes it much more

difficult to dissolve such a combination in the future, it is not expected that it will meet with favor from the members of the Interstate Commerce Commission who are opposed to the formation of new systems before the commission's plan is published. This fact is particularly interesting in the case of the new Nickel Plate System because of the importance of the railroads involved and the fact that the grouping does not follow the lines of the commission's tentative consolidation plan. The commission's plan combines the Lehigh Valley with the original Nickel Plate Line, the New York, Chicago & St. Louis, and the Toledo, St. Louis & Western, to form the trunk of its System No. 5, uses the Erie as the trunk of System No. 4, the Pere Marquette as the trunk line of a small system in the Michigan peninsula, and the Chesapeake & Ohio as the trunk line for System 8. Professor Ripley proposes a somewhat similar arrangement, equally divergent from the system that seems now to be an accomplished fact.

Southern Pacific—On the other hand, the expansion of the Southern Pacific System to include the El Paso & Southwestern and its controlled lines, by stock ownership and lease, is in line with both the commission's plan and Professor Ripley's, both of which make the Southern Pacific and the Chicago, Rock Island & Pacific the trunk of a large southwestern system. Recently the Southern Pacific has repurchased, subject to the commission's approval, the San Antonio & Aransas Pass, a property which it was forced to sell in 1903 because the Texas Railroad Commission ruled that it was a competing line. This railroad will give the Southern Pacific an operating mileage of 13,064; the Southern Pacific Lines 10,812 miles, the El Paso & Southwestern Lines 1,140 miles, the Arizona Eastern 383 miles, and the San Antonio & Aransas Pass, 729 miles. In addition, the Southern Pacific is now building 172 miles of new lines to make the El Paso & Southwestern of greater value to its system. It also controls 1,323 miles of railway in Mexico. There is little doubt that the commission will approve of the acquisition of the San Antonia & Aransas Pass as it is included with the Southern Pacific in its System 17.

Other Consolidations—Early this year the directors of the Chicago & Northwestern Ry., which has held a controlling interest in the Chicago, St. Paul, Minneapolis & Omaha Ry. since 1881, made an offer to exchange stock of their company for the minority holdings of the latter company. If this arrangement becomes effective it will combine 10,200 miles of the Interstate Commerce Commission's proposed Union Pacific-Northwestern System into one system.

In the South the Atlantic Coast Lines and its subsidiary, the Louisville & Nashville, have leased the Carolina, Clinchfield & Ohio; a grouping approved by the commission and included in its tentative plan for the Atlantic Coast Line-Louisville & Nashville System as an alternative to including the C., C. & O. in the Illinois Central-Seaboard System. Professor Ripley assigns the C., C. & O. to a system built up around the Southern Ry.

A similar move in conformity with the commission's plan for a greater Illinois Central System is the purchase of the 307-mile line of the Gulf & Ship Island R.R. by the Illinois Central; but the application of the same road to lease the Alabama & Vicksburg and the Vicksburg, Shreveport & Pacific does not agree with the commission's plan or Professor Ripley's. This application has not yet been acted upon by the commission.

Besides these definite moves towards consolidation, there are persistent rumors of other combinations in the West and the more definite information concerning the proposed four new system in the East, plans which have gone so far as to have hearings before the commission but which seem to be a long way from accomplishment on account of the importance of the systems involved.

There is no indication now that the Interstate Commerce Commission will publish its general consolidation plan at any time in the near future. The general impression seems to be that the commission will let the work of voluntary grouping go on, exercising what control it feels necessary as each case develops. Such an arrangement is somewhat along the lines of the President's recommendation to Congress made in his message on the subject in 1923. It has many advantages over attempts to force consolidation, particularly at this time when the valuation of so few railroads has been fixed. Any compulsory consolidation plans almost immediately will run up against the efforts of the owners of the absorbed lines to obtain the best price they can for their property, on the one hand, and the objections of the commission to the payment of an excessive price, on the other (because such excessive price when approved by the commission becomes a basis for a claim for increased return), and so a voluntary grouping, while it does not always agree with what may be outlined as the theoretically best grouping, does, in actual practice, attain an end which otherwise seems impossible of attainment.

Canted Rails Again Adopted in France

Standard railroad practice in France has been to place the rails with an inward inclination of 1 in 20, conforming to the taper of the wheel treads, but in 1918 the conference of engineers of maintenance-of-way adopted the vertical position as standard. Observations made on vertical rails on the Eastern Ry. in 1921, after six to twelve months' service, showed deep wear on top of the head along the gage side, with a projecting lip due to flow of the metal. At the leaving end also there was a similar lip. On curves the rails were pushed outward and even on easy curves the rail flanges had cut or worn the spikes as a result of the outward thrust. Wooden tieplates also showed a greater reduction in thickness under the outer side of the rail. On a 120-mile test section of the track on the Northern Ry., the formation of the lips on the inner side of the rail heads and at the ends soon became evident. The Paris & Orleans Ry. also found that there was a widening of gage and that the wear of the rail heads approximated to the slope of the wheel tires. A 120-mile test section on the State Railways, laid in 1916 with 90-lb. rails placed vertically, showed a slight widening of gage, an inside lip of the rails and a compression of the tie under the outer side of the rail flange. On this line, however, the speeds were low and the traffic was light. Following these results, the conference of engineers of maintenance-of-way decided to revert to the former standard with rails inclined 1 in 20, except at frogs and switches, where the vertical position gives a more convenient construction. A small number of test sections with vertical rails were retained, however, for the purpose of continuing the observations.

B. & O. R.R. Completes Track Elevation at Pittsburgh

Three Million Dollars Spent in Two Miles—Track Elevation Ends Joint Operation of Congested Tracks by Two Railroads—Changes Made Possible by Highway Relocation

By W. M. Ray
Assistant Engineer, Baltimore & Ohio R.R., Pittsburgh, Pa.

THE MAIN LINE of the Baltimore & Ohio R.R. in passing from East to West through Pittsburgh enters the city from the East along the right bank of the Monongahela River, which it leaves at Laughlin Junction to cross the base of the triangular peninsula between the two rivers. At this summit it passes through Schenley Tunnel 2,870 ft. long and then approaches the Allegheny River crossing by 33rd St. viaduct, a track elevation completed in 1916. The Allegheny River bridge as reconstructed in 1920 to the higher elevation required by the United States War Department reaches the right bank of that river at an elevation about 25 ft. above the adjoining tracks of the West Penn R.R., a part of the Conemaugh Division of the Pennsylvania R.R.

Prior to the completion of the improvement which is the subject of this description, the Baltimore & Ohio tracks descended a 0.9 per cent grade parallel to the river and connected with the West Penn tracks at Millvale using two tracks under a joint operation agreement for a distance of 1.3 miles to the borough line of Etna, Pa., where it left the West Penn tracks turning to the left to ascend the valley of Pine Creek.

The increasing traffic on both of the railroads finally caused such congestion on the joint tracks that a separation of the grades and of the traffic of the railroads became necessary. A proposal to relocate and improve the old Butler Plank Road, known as Route 70-72 by the State Highway Department of Pennsylvania opened the way for the construction of Baltimore & Ohio tracks between the highway and the West Penn R.R.

The Millvale to Etna track elevation included there-

FIG. 1—BALTIMORE & OHIO TRACKS IN PITTSBURGH DISTRICT

fore: (1) raising the Baltimore & Ohio tracks to cross over the West Penn R.R. at their old point of junction at "BN" tower and the construction of independent road bed and tracks to the former point of divergence at old "PC" tower; (2) the rearrangement of the West Penn tracks into a four-track system, extending the reconstruction of that line recently completed through Allegheny; and (3) the relocation and reconstruction of the state highway.

The principal structures on the track elevation are a 25-ft. concrete arch 128 ft. in length over Girtys Run in Millville, costing $100,000, and the concrete-steel

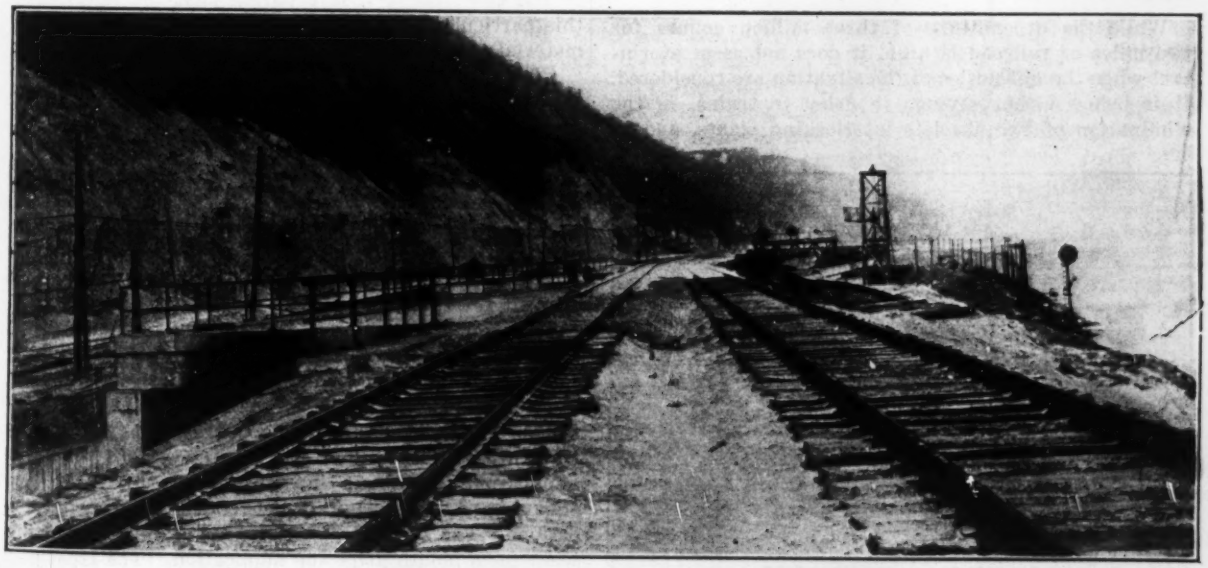


FIG. 2—UNFINISHED B. & O. TRACKS AT CROSSOVER BRIDGE
Relocated Butler Plank Road at left, and West Penn tracks on lower level at right.

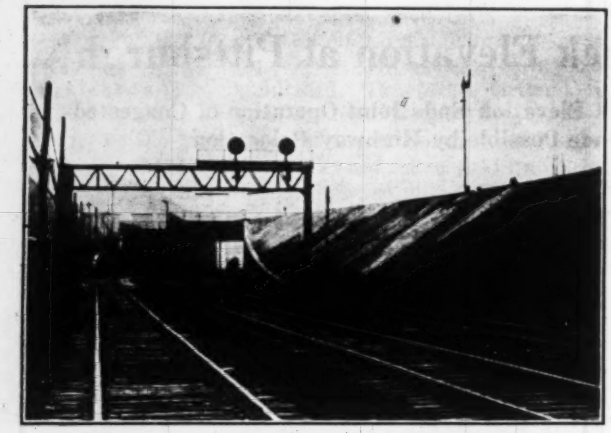


FIG. 3—COMPLETED TRACK ELEVATION
West Penn tracks in foreground and B. & O. tracks elevated at the right.

ballast-deck bridge carrying three Baltimore & Ohio tracks over four West Penn tracks at a skew of 12 deg. 30 min., at a cost of about $400,000.

West of the crossing of the West Penn tracks, the relative position of the thoroughfare is: (1) State highway, next to bluff, (2) Baltimore & Ohio R.R., 2 tracks, (3) West Penn R.R., 6 tracks, (4) Allegheny River.

Work on this improvement was begun by the Baltimore & Ohio R.R. in October, 1923, the new elevated main tracks were put into service in November, 1924, and all interchange and yard connections including the double track line to Allegheny were in operation in January, 1925.

Considerable work yet remains to be completed under traffic, including the raising and reconstruction of Bridge No. 314 over Pine Creek and replacing the present temporary bridge over 43rd St., Millvale, by permanent work; but the essential objectives of separation of traffic with the West Penn R.R. and substitution of 0.5 per cent compensated grade for the former 0.9 per cent approach to Allegheny River Bridge are attained.

While the expenditure of three million dollars for two miles of railroad is high, it does not seem exorbitant when the difficulties of the situation are considered. It is believed that savings in delay to trains, in the elimination of two obsolete interlocking plants, and in the greater flexibility of operation and increased capacity of both railroads will more than justify the cost of this improvement.

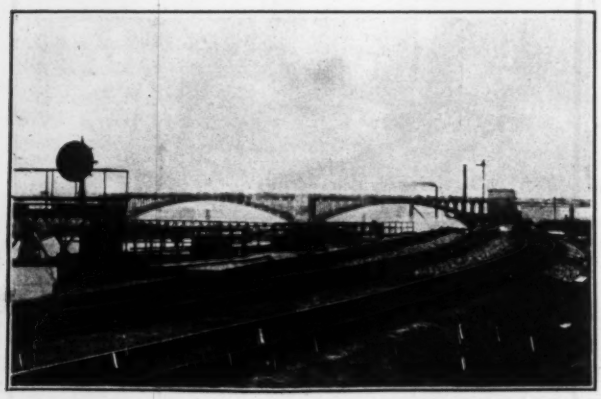


FIG. 4—B. & O. TRACKS ON NEW CROSSOVER BRIDGE
New 40th Street highway bridge in background.

The engineers in charge of the work were, for the Baltimore & Ohio R.R., H. A. Lane, chief engineer, P. G. Lang, Jr., engineer of bridges, A. C. Clarke, district engineer, and the author, assistant engineer; for the Pennsylvania R.R. (West Penn R.R.), A. C. Shand, chief engineer, George Nauman, assistant chief engineer, and T. P. Watson, assistant engineer.

Dust Laying on Surfaced Roads in California

Use of Hygroscopic Salts an Economic and Effective Method on Gravel or Crushed Rock Roads

By H. S. Comly
Division Engineer, California Highway Commission, Dunsmuir, Calif.

During the past three years, the California Highway Commission has experimented with calcium chloride and magnesium chloride as dust preventives on graveled and crushed rock roads in northern California. These salts were applied on about 32 miles of state highway in varying amounts and under varying conditions of road surface and of atmosphere, considering the humidity. Sections treated were on the Pacific Highway between Redding, at the head of the Sacramento Valley, and Yreka, on the Klamath River drainage. The two places are 115 miles apart.

This section of the highway traverses several types of country, including large open valleys, foothills and rugged mountains, large areas of arid lands devoid of natural vegetation, and heavily timbered mountains with many well watered streams. The altitude varies from 500 to 3,500 ft. and the humidity along the entire section is very low during summer months. There is never any dew on the grass in the mornings and fog is practically unknown during the summer months. As the efficacy of the hygroscopic salts as a dust preventive on highways depends directly on the moisture in the atmosphere, it is apparent that the selection of this particular location was a rather severe test of the materials used.

First Section Treated—The first piece of highway treated was a stretch of four miles in the canyon of the Sacramento River, near its headwaters, between the towns of Castella and Dunsmuir. This road had a surface of crushed rock of 2-in. maximum size, but during the course of several years' maintenance the surface had become permeated with the red sedimentary soil peculiar to this section. This soil has a rather strong clay content which we now realize is an essential element for this treatment in dry atmosphere.

The material used was commercial granulated calcium chloride containing 75 per cent of the pure hygroscopic element. The first application was made in July, 1922, at the rate of 2½ lb. of the commercial salt to the square yard of surface. The surface was thoroughly smoothed and saturated with water, after which the application was made in two courses of 1¼ lb. per square yard each, about 10 days elapsing between applications. The surface was sprinkled at intervals of one week for a month after the application. The treatment of this piece held the road fairly satisfactorily under a traffic of about 1,200 vehicles per day during the re-

mainder of the summer of 1922, although just before the fall rains set in it appeared to have lost much of its efficacy.

However, in the spring of 1923, during the period of the later rains, a second application of 1 lb. per square yard was made and the road was kept thoroughly well smoothed until the rains ceased and the road had finally dried for the summer. During the following summer months the road carried more than 1,500 vehicles a day and remained smooth, firm and dustless without any other maintenance of its surface. It might be well to mention that on the adjacent 40 miles of road to the south we spent about $700 per mile during these summer months in operating sprinkling trucks and drags in an effort, only partially successful, to hold the road under this same traffic.

Slate Surface Road—During the summer of 1923 a stretch of three miles of crushed rock surface in the lower Sacramento canyon near Pollock was treated with about 1¾ lb. per square yard of commercial granulated calcium chloride. The rock surface was a moderately hard slate, and, while this rock makes a smooth durable wearing surface in itself, the surface is quite impermeable and has little binding or sticking qualities. We soon learned that the small amount of moisture in the atmosphere was not sufficient to hold this type of surface effectively under a traffic of 1,000 vehicles per day and that, therefore, the treatment was not economical unless a proper amount of suitable binder soil was incorporated with the surface. Practically all traces of this treatment disappeared within six weeks after its application, although for the first three or four weeks it was quite effective. The expense of adding binder in this particular location was too great and no further applications were made on this stretch.

Early in the spring of 1924 a stretch of two miles of graveled highway in the northern end of the Sacramento Valley at Redding was treated with 3½ lb. per square yard of commercial granulated calcium chloride, applied in two courses. The gravel in the road surface was a round creek gravel impregnated with a considerable amount of sand containing a large percentage of iron stained clay wash. The moisture in the atmosphere in this section is somewhat less than in the preceding two cases. This stretch sustained a traffic of about 1,500 vehicles per day very effectively through the past summer. A light sprinkling was given it about once a month because of the extreme dryness of this season. It should be noted that this stretch was subjected to a large traffic of 5-ton trucks which were used on an adjoining paving contract. We expect that another application of about 1 lb. per square yard in the spring will hold this road in good condition.

Crushed Gravel Section—During June and July of 1924, 25 miles of crushed gravel highway in the Shasta Valley south of Yreka were treated both with commercial granulated calcium chloride and calcium chloride in solution, and also a portion with magnesium chloride in solution. Separate stretches were treated with each material applied in equal amounts per square yard, based on the actual anhydrous salt content of each material. Equal conditions of surface were approximated as nearly as possible in order to make a fair test of each material. Bearing in mind our previous experience, an effort was made to supply the surface with the proper amount of binder soils. The atmosphere in the Shasta Valley is very dry except that a small area is devoted to irrigated alfalfa fields and the atmospheric moisture present in this area was very noticeable in its effect on the treated highway passing through it.

All of the salts used were applied at the rate of 1.3 lb. per square yard of the anhydrous element contained in them, which is equal to 1¾ lb. of the commercial granulated calcium chloride. One mile of the road was given a second application of magnesium chloride immediately following the first application, each application containing 1.3 lb. per square yard of the anhydrous element. All portions of these 25 miles carried an average of 1,500 vehicles per day during the last three months of an exceptionally dry summer season without other maintenance than a light sprinkling every two weeks. The road remained quite dustless and equal to a pavement in riding qualities, particularly the portion on which a double application was made. An equal coat of each of the materials will be applied this spring and it is expected that this treatment will hold the road satisfactorily without maintenance through next summer's traffic, which will probably reach more than 2,000 vehicles a day.

It is not possible at this early date to reach any definite conclusion as to the relative merits of each of the materials used but the conditions to date point to the conclusion that the relative order of effectiveness is magnesium chloride in solution, granulated calcium chloride and calcium chloride in solution.

Conclusions—The cost of the application of these hygroscopic salts, using equal amounts of their anhydrous elements per square yard of surface, is practically the same for each material in this section of California. The cost of application, exclusive of providing binder for the surface, using a strip 20 ft. wide and 2.6 lb. of the anhydrous element per square yard for the first year, amounts to $900 per mile of road in Northern California. The cost of a light application each succeeding year, say 1 lb. of the anhydrous element or 1¼ lb. of the commercial salt, would be about $300 per mile. Our experience leads us to believe that this process may be continued efficaciously for an indefinite period, but, assuming that the treatment will be effective for three summer seasons only, the average summer maintenance cost for the road surface alone will be about $600 per mile. This will provide a road surface practically equal to a pavement in comfort and ease for traffic and will stand up under a traffic of up to 1,500 vehicles per day. Our experience shows that in maintaining gravel and crushed rock roads under this volume of traffic by the ordinary means of sprinkling, dragging and adding new crushed rock, the cost will average more than $1,000 per mile per summer. While this expenditure will maintain a smooth road, it will still be quite dusty and uncomfortable for the traveler when vehicles are forced to travel so close together as this volume of traffic makes necessary.

Our conclusions derived from the above experience are that the use of these hygroscopic salts is an economical and effective method of maintaining gravel or crushed rock roads which are subjected to a heavy volume of traffic. The amount of the material required and consequently the cost of the maintenance will depend on the humidity of the atmosphere. The judicious use of a suitable binder material is essential to effective results in the drier atmospheres and an

aid to good results in the more moist atmospheres. It is highly essential that a road surface be provided which, with the amount of moisture the particular atmosphere will provide through the agency of the salt, will form a surface thoroughly resistant to the suction of rubber tired traffic. If the road surface is such that the small amount of water drawn from the air will not produce this result, the effectiveness of the treatment will of course be lost. It is not reasonable to expect, therefore, that this treatment will be effective on a surface of small gravel or rock alone, except possibly in the most humid atmospheres. In providing binder in the surface, however, great care should be exercised not to use an excessive amount of clay-like binder, otherwise the surface will not be suitable in wet weather.

Columbia Basin Project to Cost Two Hundred Millions

Board of Engineers Reports on Five Plans Costing $157 to $229 Per Acre—Settlement Likely to Be Slow

AN OUTLINE of the report on the Columbia Basin project recently submitted by a special board of engineers has just been made public by the Department of the Interior at Washington. The full report will not be made public until reviewed by a departmental commission consisting of Dr. Elwood Mead and Francis M. Goodwin, former assistant secretary of the Interior. The board of engineers consisted of L. C. Hill, Joseph Jacobs, Charles H. Locher, R. R. Lyman, A. J. Turner, and C. L. Waller.

Five Plans Discussed—Five different irrigation plans are discussed in the report. Two of these are gravity plans, two pumping plans, and two combined gravity and pumping. They are as follows:

Maximum High-Line Gravity Plan—Water from Pend Oreille and Coeur d'Alene Lakes; irrigable area 1,883,000 acres; cost $157 per acre, or $296,510,548 total; initial expenditure to irrigate the first lands, $66,756,891.

Minimum Gravity Plan—Water from Pend Oreille Lake; irrigable area 1,054,000 acres; cost $163 per acre, or $171,826,554 total; initial expenditure to irrigate the first lands, $48,350,816.

Minimum Gravity Plan Including Pumpage—Water from Pend Oreille and Coeur d'Alene Lakes; irrigable area 1,224,000 acres; cost $158 per acre, or $193,359,595 total; initial expenditure to irrigate the first lands, $54,000,000.

Maximum Pumping Plan—Water from Columbia River; irrigable area 1,532,000 acres; cost $197 per acre, or $301,499,185 total; initial expenditure to irrigate the first lands, $107,936,156.

Minimum Pumping Plan—Water from Columbia River; irrigable area 1,037,000 acres; cost $229 per acre, or $236,842,561 total; initial expenditure to irrigate the first lands, $106,173,174.

According to the outline, the board regards the pumping plans as less attractive than the gravity plans because of the high per-acre cost of pumping and the fact that 350,000 acres of the best lands can not be reached.

Some phases of land settlement are discussed including adaptability of the land to diversified crops, climate and growing season, transportation to eastern and foreign markets, elimination of land speculation, and farm credits. It is estimated that the net capital required of a settler on the proposed project will be from $2,500 to $4,500 to commence operations. The board estimates 25 years as the maximum time in which the entire irrigable area would be settled by farmers and the land under cultivation.

A carefully worked out schedule of farm operations indicates that an 80-acre farm in the more favorably situated lands of the project will at the end of the fifth year return a gross annual revenue of $4,100, of which $1,300 would be available for debt reduction. It was similarly estimated that an 80-acre farm of second-grade land will return a gross annual revenue of $3,200, of which $1,000 would be available for debt reduction.

Discussing secondary and emergency storage, the report calls attention to the lakes in the Columbia Basin area formed by Gamden, Deep Creek, Deadman Creek, Latah Creek, and Rock Lake dams, which afford an opportunity to conserve water in case of shut-down below Rock Lake. This storage affords some wasteway protection and also materially shortens the time required to resume service after a shut-down. There are secondary reservoir sites within the project which may be utilized to improve operating conditions, conserve drainage and waste water and, by furnishing water at a critical time, carry the peak demand and permit a further reduction in canal capacity.

Along the distribution canals there are numerous drops and chutes where power may be developed. In the maximum gravity plan 30 power sites are practicable, with 145,000 hp. combined installed capacity, at average cost $58 per horsepower. The engineers recommend that net returns from power sales should be applied to the retirement of the capital cost of the proposed project.

The principal conclusions reached by the board are:

That there can be included in the maximum project, which can be served from the Spokane and Pend Oreille Rivers, or from Pend Oreille alone, 1,650,000 acres by gravity and 233,000 acres within a 100-ft. pumping lift, making a total reclaimable area of 1,883,000 acres.

That while the construction cost per acre is high, there are no engineering features out of the ordinary, excepting the size of the canals.

That the high cost per acre of the Columbia River pumping projects, the fact that they involve a permanent loss to agriculture of about 350,000 acres of the best lands, and the greater initial expenditures required, make them less attractive than the gravity projects.

That the state should assume its proper share of the responsibility for collecting payments from the settlers, and should also bear its proper share of the losses, if any, incident to the development of the project.

That the 1,224,000-acre project, 80 per cent of which is Class A land, and which utilizes both Spokane River and Pend Oreille River as its water supply source, is the most desirable of the projects.

President Coolidge Signs Temple Bill

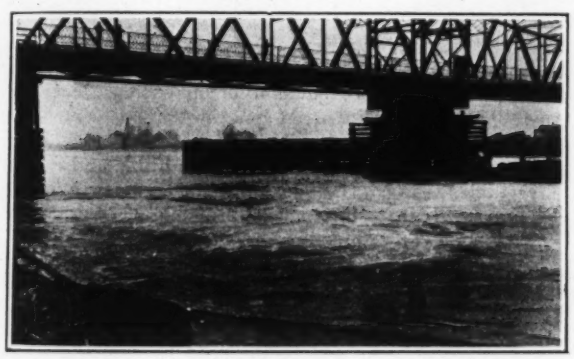
The President on Feb. 27 signed the Temple bill authorizing $950,000 for the first year's work on a twenty-year program which provides for the completion of the topographic map of the United States. The entire program calls for the expenditure of $50,000,000. The complete map will consist of 6,000 sheets. Topographic mapping has proceeded very slowly in past years. As the country has developed the demand for exact physical surveys of each square mile of the country's area has become more and more pressing. They have been particularly needed in connection with highway and drainage development. For forty-five years the United States Geological Survey has been doing just as much mapping as funds would allow, but because of their inadequacy only one-third of the country has been adequately mapped.

Driving a Small Tunnel Under Air Pressure at Seattle

Air Loss of 4,000 Cu.Ft. per Minute While Driving 8-Ft. Tunnel Under 25-Lb. Air Pressure Through Wet Sand

THE TUNNEL under the Duwamish waterway at First Avenue South in Seattle, Wash., is being driven under contract for the city to increase the city's water supply to the southwestern portion of the city. The horizontal part of the tunnel, which will be 414 ft. long, is some 60 ft. below mean low tide level and will have a circular section with a diameter of 8 ft. inside the concrete lining. Vertical shafts 10 ft. in diameter, also concrete lined, on either side of the waterway, are to connect the tunnel with pipe lines on the surface. This will not be a pressure tunnel; steel water mains and other utility lines being carried through it.

Despite the fact that the concrete lining is kept up as close to the heading as possible and although building paper and mud plaster are placed carefully in the temporary lining as fast as the heading is advanced, air escapes so rapidly that the compressors take 4,000 cu.ft. of free air per minute to maintain a pressure of 25 lb. per sq.in. in the tunnel. The escaping air comes to the surface of the water anywhere up to 100 ft. away from a point directly above the heading. In an endeavor to

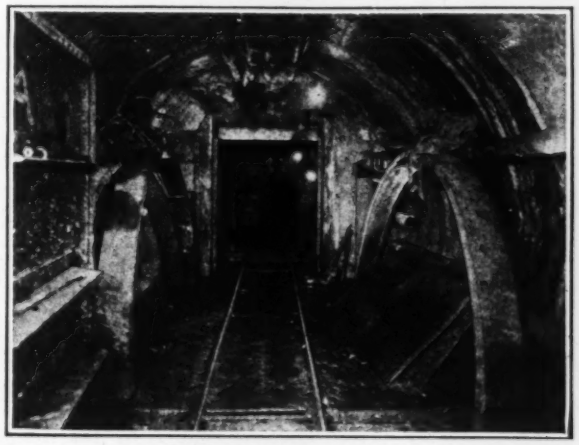


WATER SURFACE OVER TUNNEL AGITATED BY ESCAPING AIR

reduce the escape of air, clay has been dumped from barges along the center line of the tunnel and for a width of 50 ft. on either side, the plan being to overlay the full length of the tunnel with a mud blanket 100 ft. wide.

Work in the tunnel is advanced with three shifts and the average progress per day is about 4 ft. of concrete-lined tunnel. The crews range from 14 to 19 men per shift, the variation being due to the fact that more men are needed on the shifts that place concrete while on the other hand some of the men such as carpenters normally work only on daylight shifts, regardless of the operations in progress underground.

The entire length of the tunnel is being driven from the north shaft, where the compressor plant is located. The air lock was placed in the horizontal portion of the tunnel on this end but about 50 ft. in from the bottom of the shaft, thus affording trackage in the tunnel itself but outside the air lock, which greatly facilitates the handling of muck cars. Cars of muck coming out and empty cars going in are all handled by one lock tender, aided on the compressed air side by one of the muckers. When the heading is being advanced under normal conditions the muck cars come out, two to the lock, at the rate of about six cars per hour. The lock tender puts these cars one at a time on the hoist in the shaft and



LOOKING TOWARD TUNNEL HEADING FROM AIR LOCK

then takes empty cars back through the lock into the tunnel.

The material encountered throughout the length of the tunnel is coarse black sand which at this depth has very little clay in it. It is handled very easily, being shoveled from the heading into the muck cars, but is highly porous so that entire dependence has to be placed on air pressure to keep out the water.

The advance at the heading is made 3 ft. at a time, and after every two advances the heading is carefully plastered and mucking is stopped while concreting operations are in progress. One attempt was made to advance the heading 6 ft. at a time but this brought such warnings of collapse at the tunnel heading that the experiment was not repeated.

The method of advance is to shovel out the sand at the top 3 ft. ahead of the completed work and place 1 x 12-in. boards on sides, roof and breast. These boards are put in one at a time and as soon as a considerable area is thus covered building paper is put over the boards and at the joints is plastered with clay. When top and sides have been entirely covered with 1-in. boards and paper, 3-in. lagging is put in, and is likewise papered and plastered, thus completing the timber or temporary lining (against which concrete is later poured). The breast boarding is then removed and another 3-ft. advance made. At the start of this second 3-ft. advance two 6 x 6-in. longitudinal timbers are put in to hold the roof boards. These timbers rest on the top of the arch at the forward end of the concrete lining and extend forward a little more than 6 ft. to posts on each side of the heading. These posts are placed on sills and carry jacks to take up settlement.

Mud of a consistency such that it can be readily molded and plastered with the hands is brought into the tunnel in muck cars and is used freely to cut down the loss of air. The hissing sound of escaping air is plainly heard as it rushes out through cracks between boards and these the men endeavor to stop with clay and paper. Air escapes rapidly wherever the sand in the upper parts of the drift is exposed and every en-

deavor is made to put the lining in as quickly as possible after each new advance.

The air pressure is sufficient to support sides and roof so that timber framing or sets ordinarily required in tunnels through soft material are not needed. In other words, the boards and building paper make a lining with so much resistance to air that the compressed air balances the pressure of the surrounding material.

When an advance of about 6 ft. has been made and the lining is tightly plastered, the one set of concrete forms kept in the tunnel is removed from the previous position and set up in the advanced position to receive a new pour.

The concrete lining is unreinforced and 16 in. thick; and a 1:2:4 mix is used. The forms are made of steel ribs with timber lagging; they are collapsible and self-supporting so that when set up they carry the weight of green concrete without obstructing the tunnel. They are made up in the form of hoops of channel iron, 8 in. wide, assembled in 180-deg. sections. Concrete is shoveled into the forms by hand.

An airtight safety door is located in the tunnel 100 ft. in from the air lock. Timbers for an emergency bulkhead are kept in the tunnel constantly and are to be used to close off the heading in case of a break which would allow bulkheading thus far ahead of the safety door.

On Nov. 1 the horizontal portion of the tunnel had been driven a total of 160 ft. from the north shaft, and the time of completion of the driving and lining was about December 15.

Work on this tunnel is under the general direction of J. D. Blackwell, city engineer of Seattle, and T. H. Carver, water supply engineer. The contract is held by the Puget Sound Bridge and Dredging Co., for whom George T. Forsythe is superintendent on the Duwamish water-way tunnel.

Public Health Engineering Problems in Chicago Area

Abstract of Paper by Arthur E. Gorham, Chief Sanitary Engineer, Chicago Department of Health, Presented at the Midwinter Convocation of the Western Society of Engineers.

CHLORINATION of the water supply and its effective control, lake pollution by the Calumet River and lake front improvements, protection of the water tunnel system, cross-connections between a polluted supply and the public supply, water supply for vacationists, bathing beach pollution, swimming pools, mosquito control, rat-proofing, housing and air-conditioning are the sanitary engineering problems confronting Chicago.

The Calumet River flows into Lake Michigan, polluting the water supply 42 per cent of the time, not only with sewage but industrial wastes to such an extent that any ordinary chlorine dose is completely absorbed. Lake shore improvements seriously threaten the water supply, making a pollution that is rapidly increasing beyond the possibility of chlorination. Sewage from vessels, if Chicago becomes a world port, will make a much more rigid supervision essential.

The 35 miles of water tunnels and 50 land shafts need careful attention to protect them from surface pollution. Last year serious pollution of shafts was found and $50,000 has been appropriated to line or seal the leaking shafts. Cross-connections in 191 cases were found in 1924. There is need of increased plumbing inspection.

Rat-proofing at enormous costs faces the city when it becomes a world port.

The pollution of the air by monoxide of automobiles needs careful study but none has yet been initiated.

First Cost, Durability and Capacity Basis of Washington Conduit Award

FIRST cost, with correction factors for relative durability and carrying capacity, was the basis of comparing bids for five possible kinds of pipe to be used in a new force main for the water supply of Washington, D. C., at a recent letting. Bids were invited for cast iron, three types of steel—welded, lock-bar and riveted—and reinforced-concrete pipe. The bids for cast-iron pipe included both ordinary and cement-lined, of which there were some nine on each. There were two bidders on reinforced-concrete pipe. As a result of the official comparison of the lowest bids on first cost, with the readjustments for durability and capacity (see table), the contract was awarded to the Lock Joint Pipe Co., which is now assembling plant for the work.

BIDS FOR WATER CONDUIT AT WASHINGTON, D. C. JAN. 15, 1925

	Lock Joint Reinforced Concrete Pipe	Unlined Cast-iron Pipe	Cement-Lined Cast-Iron Pipe	Steel Pipe with Bituminous Enamel Coating
First cost				
Lowest bids for the several kinds of pipe	$283,950.00	$370,070.50	$387,088.50	$358,800
Durability				
Capitalization of yearly sinking fund to replace pipe at end of its estimate life				
Steel pipe 35 years				90,925.22
Concrete pipe 70 years	18,235.12			
Cast-iron pipe 100 years		7,327.48	7,664.44	
Carrying capacity				
Capitalization of extra annual pumping cost against greater friction	93,417.19	151,246.87	93,417.19	151,246.87
Comparative costs				
When different pipe lines are brought down to the same basis as to life and carrying capacity	$395,602.31	$528,644.85	$488,170.13	$600,972.09
Percentage relation	100	133	123	152

The basis for comparing bids for the various kinds of pipe was stated in the specifications as follows:

(a) *First Cost*—First cost will be obtained from bids received.

(b) *Durability*—The adjustment in cost of the pipe for the durability factor will be obtained by capitalizing at 4 per cent, compound interest, the annuity or yearly sinking fund necessary to replace the pipe at the end of its estimated life, which will be taken as 100 years for cast-iron pipe, 70 years for reinforced-concrete pipe, and 35 years for steel pipe.

(c) *Carrying Capacity*—The adjustment in cost of the pipe for the carrying capacity factor will be obtained by capitalizing at 4 per cent interest, the extra annual cost of pumping against the friction losses, calculated on the basis of the Williams and Hazen formula with C equal to 100 for the cast-iron and steel pipe and 130 for the concrete pipe and the cement-lined cast-iron pipe, with the flow estimated at 26,000,000 gallons per day, and the cost of power at 5 cents per million gallons per foot lift.

The adjusted bids will be taken as the sum of the amount bid and the respective adjustments in cost. This adjustment will be used for comparison of bids only.

The riveted steel pipe will be made 50 in. in diameter to make its carrying capacity approximately the same as 48-inch cast-iron or welded steel pipe and the smaller riveted steel pipe will be made 26 in. in diameter.

The contract includes 13,400 ft. of 48- and 1,500 ft. of 24-in. pipe, together with fittings in both cases. The estimated quantities of excavation were 25,000 cu.yd. of ordinary work and 500 cu.yd. of rock. The force main will convey water from the new filtration plant at the Delacarlia reservoir to connections with the distribution system near the Georgetown reservoir.

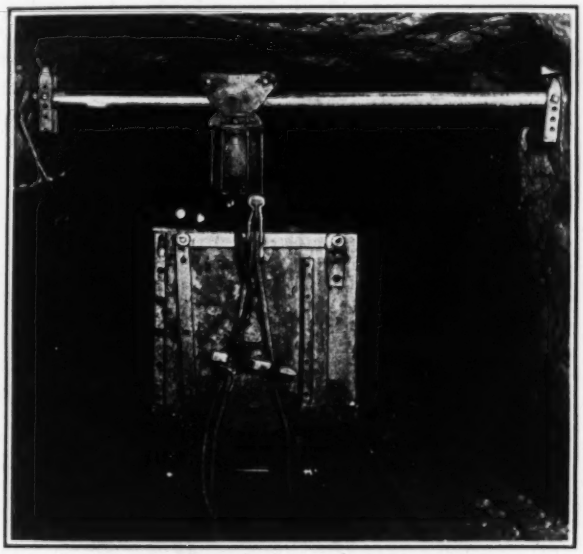
From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

New Devices in the Moffat Tunnel

PROGRESS in driving the six-mile Moffat Tunnel through the Rocky Mountains near Denver, Colo., is being expedited by a number of special appliances, some of which were designed on the work.

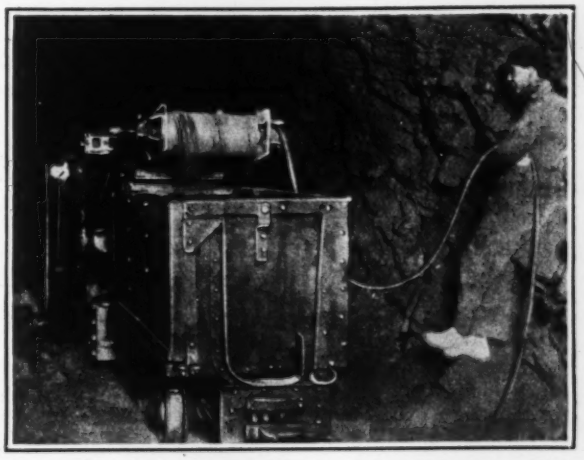
Muck-Car Switcher—The air-hoist device shown in the accompanying view picks up the muck cars and shifts them laterally, thus eliminating the delays, derailments and labor difficulties of switching the cars by a portable switch and siding to reach the mucking machine in the heading. This hoist has an operating cylinder suspended from a two-wheel trolley running on a 3-in. steel bar whose ends are supported by shackle bolts hanging on drill rods driven into the side walls



AIR-HOIST SWITCHES MUCK CARS

of the tunnel. To the piston-rod of the cylinder is attached a piece of rail or small I-beam slightly longer than the muck car and having at each end a hanger to engage the bottom of the car frame. Operating valves are placed conveniently about 4 ft. from the ground, in the air line leading to the hoist cylinder. This air-hoist car-switcher is the invention of Orren Allen, of the staff of the Moffat Tunnel Commission, who has applied for patents.

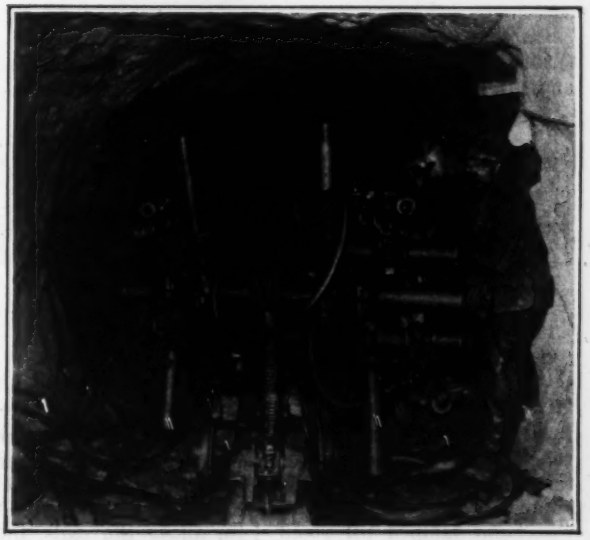
Mucking Machine—In the 8x8-ft. headings effective work is being done by the Conweigh mucking machine, built by the Conveying Weigher Co., St. Louis, Mo. A heavy frame mounted on a track of 24-in. gage and chain driven from a 50-hp. motor is equipped with an apron and scoop that swivel from side to side on a 10-ft. arc. By driving the machine ahead the scoop is made to root into the muck pile until loaded, when it is lifted with the apron, which acts as a chute to feed the muck back to an endless rubber belt conveyor which carries the muck over the rear of the machine and discharges it into the cars. This mucker with an operator and



MUCKING MACHINE LOADING MUCK CAR

three helpers loads a car of 50 cu.ft. capacity in about two minutes and averages about 50 tons in two hours, so that the 8x8-ft. heading is always mucked out within three hours after shooting. The cost of loading is given as about 75c. per cubic yard, which includes power, maintenance and labor.

Drill Carriage—A drill carriage that can be moved quickly up to the breast after mucking operations are finished has been developed by adapting the Ingersoll-Rand machine to local needs. Four wheels running on a 24-in. track carry a channel-bar frame on which runs a trolley with 4-in. vertical steel columns on each side, held together rigidly by horizontal cross-bars that extend toward each side wall with screw jacks at the ends so that they can be held tight against the rock when the machine is set up for operation. The front



DRILL CARRIAGE USED IN 8x8-FT. HEADING

end of the carriage frame rests against the rock at the foot of the breast. At the rear of the frame are air and water manifolds from which individual lines of hose run to each of the four drills. The air is bypassed through an oil chamber to lubricate the drills.

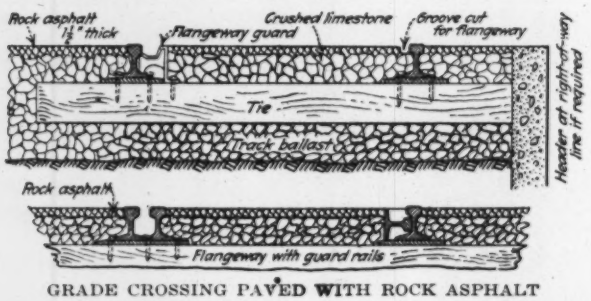
In setting up, one air connection and one water connection to the tunnel pipe lines are made, the jacks on the ends of the cross-bars are screwed against the side-walls, then the drills are shifted on the cross-bars so as to make the required angles at the face. From 8 to 15 minutes from the time of arrival at the breast drilling is begun. Thus it is possible for one drill crew using the same four drills to drill both water tunnel and main heading in one shift by alternating with the mucking crew and moving the drill carriage from one heading to the other through the nearest crosscut.

Paving Railway Grade Crossings with Kentucky Rock Asphalt

IN THE paving of street and highway grade crossings by railways there is increasing use of permanent construction in order to provide a durable surface which is economical in first cost and maintenance. Several railways are using for this purpose a surface of Kentucky natural rock asphalt on a base of crushed stone covering the gravel or stone ballast. Among the advantages claimed for rock asphalt are that it makes a smooth and durable surface, does not require heating and can be applied by section gangs, while a stock for repair or maintenance can be piled near the crossing without deteriorating. If the paving should have to be disturbed, the asphalt surface can be broken up and kept separate, ready for replacing. The asphalt is specified to have from 7 to 9 per cent of natural bitumen and the sand to contain not less than 95 per cent silica.

Typical construction for grade crossings is shown in the accompanying drawing, with four methods of forming the flangeways. The specifications provide that the track should first be put in good condition and well ballasted; a base course of ½- to 3-in. limestone, well rolled or tamped, is then filled level with the underside of the rail heads; limestone screenings are used to fill the surface voids. Water is then applied and rolling continued until a dense foundation is formed. Surplus screenings are brushed off to leave a roughened surface.

On this rough dry surface the ½-in. rock asphalt is spread to a thickness of about 1 in. above the rail head and after being raked to shape it is rolled once a day



GRADE CROSSING PAVED WITH ROCK ASPHALT

for three days with a 10-ton roller or 8-ton tandem roller. This heavy compacting is desirable but hand tamping may be used, while on work done by the Cleveland, Cincinnati, Chicago & St. Louis Ry. the asphalt was hand tamped till about ½-in. above the rails and

From Job and Office

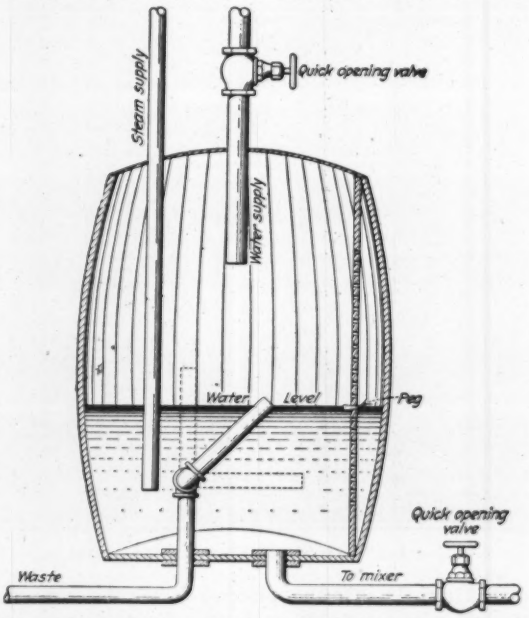
Hints that Cut Cost and Time

then finished with a roller made of a 24-in. cast-iron pipe filled with cement and having the bell knocked off. On work done by contractors the power roller is generally used, but where it is done by railroad forces such a roller is rarely available. The plans and specifications described were prepared by P. S. Bookwalter, chief engineer, and George W. Rapp, construction engineer, Ohio Valley Rock Asphalt Co., Cincinnati, Ohio.

Control of Concrete Mixing Water

BY A. W. MUNSELL
Assistant Engineer, Philadelphia River Bridge Joint Commission, Philadelphia, Pa.

THE attached sketch shows the water barrel which has been adopted for the concrete mixing plants on all Delaware River bridge contracts. The barrel is an ordinary 50-gal. capacity wooden barrel with a wooden



BARREL FOR CONTROLLING CONCRETE MIXING WATER

strip ½x2 in. nailed to the side, and perforated every half inch from a point 3 in. above the bottom of the barrel to the top, in which a peg is inserted for fixing the amount of water to be used. The barrels are calibrated and the amount of water for each half inch of height is known. A 2½-in. pipe line, with a quick-opening valve, runs from the barrel to the drum of the mixer. To one side of the barrel through the bottom runs a 1½-in. pipe to a point 3 in. above the bottom. From there two 1½-in. Ells, connected with a short nipple, support a piece of pipe about 18 or 20 in. long (fixed by the diameter of the barrel) which controls the maximum amount of water that can be used. The height of the movable arm is set by the peg on the side of the barrel and any more water than this is wasted. A ½-in. steam line runs to the bottom of the barrel to heat the water in cold weather.

From Job and Office

For Contractor and Engineer

All the contracts in force on this work on which concrete is used have batcher plants for the measurement of aggregates and the one man filling the boxes looks after the water. The device has been found very practical in all of the installations. Water tanks have been used on some of our contracts but it has been found that unless there is both adequate volume and pressure they do not fill up fast enough or the relief valve sticks. Also, there is no satisfactory way to heat the water in cold weather.

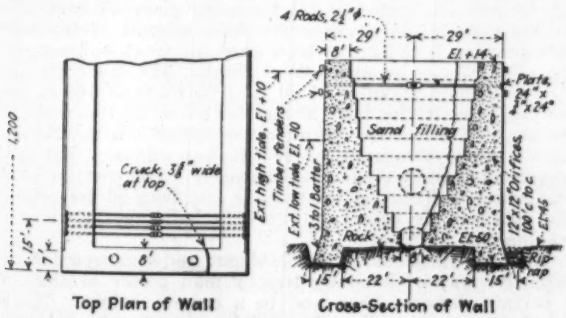
The water control device is due to Frank Fiala, superintendent for the Keystone State Construction Co., contractors for the second sections of the Philadelphia and Camden anchorages.

Tightening Anchorage Rods While Heated

BY R. Z. KIRKPATRICK
Chief Hydrographer, The Panama Canal

IN 1914, at the end of the Panama Canal construction period, the lower center wall of Miraflores Locks was spreading. This center wall extends from the lock proper for about 1,200 ft.; it is actually a dock used for taking on and off lines from ships to towing locomotives. This wall was really two walls, independent of each other, but tied together at the end by a crosswall. They were built in the dry. It was advantageous to hurry the sand interior filling by means of certain large cranes, that were about to be dismantled, preparatory to flooding the channel. Heavy rains soaked the backfilling, making heavy outward thrusts, and a crack developed, as shown in the sketch, on the far end of the 1,200-ft. wall (measured from a lock proper). Nor did the spreading stop when seawater was finally admitted, the crack becoming 3⅜ in. wide at the top of the crosswall.

The spreading was stopped by putting in four lines of 2½-in. diameter rods. Transverse holes were drilled in the walls, the rods inserted, and about 30 ft. of their lengths heated. The expansion due to the heating was then partly taken up by screwing up the turnbuckles with long-handled bars. It was not expected that the crack would close up; it was only hoped to stop the spreading. However, within one week the crack closed seven-thirty-seconds of an inch and it was filled with cement grout, after well wetting the concrete inside the crack. No further difficulty has occurred.



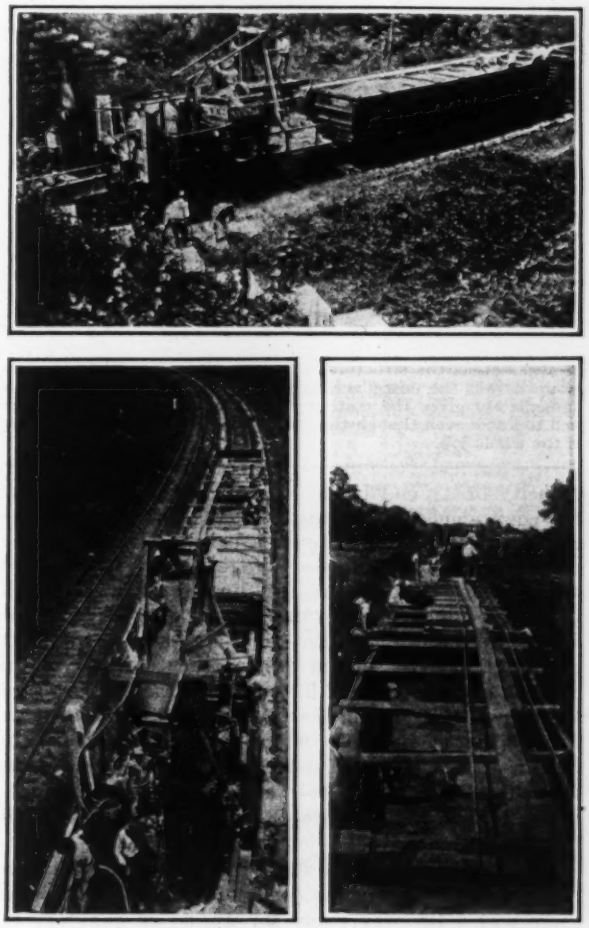
PLAN AND SECTION OF REINFORCED WALL

The sidewalls each had a mass of 69.4 tons a linear foot, and the end wall a total mass of 4,400 tons. The rods together would have taken a pull of 299 tons from each wall before passing their elastic limits. It is decidedly conjectural what pull actually existed in the rods; nor is it likely that such cases lend themselves to even approximate calculations of the stresses involved on account of spalling of concrete, bending of face plates, and even stretch on the rods.

Mixing Plant on Flat Car Supplies Concrete for Signal Bases

AN UNUSUALLY well arranged portable mixing plant was used for building the concrete pedestals of the new block signals on the Birmingham Division of the Southern Railway last summer.

The outfit consisted of an old locomotive tender, a



PORTABLE MIXING PLANT FOR RAILWAY WORK

flat car with the mixing equipment, a car of sand, a car of slag (used in place of stone), a car of cement and a caboose. The one cubic yard mixer, with its independent boiler and steam engine, was mounted on the flat car with the old locomotive tender at the boiler end and the cars of sand and slag at the other. The tender was turned with its coal hopper toward the mixing car. It supplied coal and water for the mixing operations and made them independent of the locomotive

running the train. This made it possible to spot the work train where it could pour concrete while the locomotive went for water, orders, or to put out a flag. The method of delivering sand and slag to the mixer is clearly shown in the accompanying illustration. The portable track on top of the cars was built of 16-lb. rail, and had sufficient supports, spanning from side to side of the car, to make it safe for men to work underneath. The dump car running on this track had a capacity of 1¼ cu.yd. and was made long and shallow for convenience in loading. It was dumped into the charging hopper by means of a pair of blocks and line supported by a frame over the track at the mixer and operated by passing the fall line through a snatch block to a nigger head on the main driving shaft of the mixer engine. When the slag and sand cars were empty, they were spotted beside other cars set off in convenient sidings and the portable track transferred to them without taking the track apart by sliding it on its long supporting ties which would span the space from car to car when standing on adjoining tracks. When this transfer had been completed it was only necessary to connect the movable track to the fixed section on the mixer car.

An ejector was used to draw water from the tank on the tender for use in the concrete mixer. In addition there was a two-way pump for use as an auxiliary in case the boiler could not handle both the ejector and the injector.

The cement car was not taken out with the train, as sufficient cement for a day's run could be stored on the flat car beside the charging hopper. At the other end of the flat car was a mixing box where cement mortar was prepared and handed off in buckets to the men finishing the foundation blocks.

The mixer, when slightly overloaded, could mix enough concrete for one large foundation in a single batch. This, with another charge in the hopper and still another in the dump car, made it possible to operate almost continually when out on the main line. Two chutes from the mixer, one on each side of the car, made it possible to pour at either side of the single track main line.

The average rate of pouring was 32 foundations in a day, about 25 single foundations of 1¼ cu.yd. each, and the remainder cable post foundations of ½ cu.yd. each. In this work, the actual working time out on the main line was only from three to four hours on account of the heavy traffic. From the time the train stopped at each foundation until the foundation was completed, was from five to six minutes. In all, 239 signal foundations and 141 cable post foundations were poured in twelve days. The crew consisted of 22 men on the work train and 4 on the motor cars following up to finish off the tops of the blocks.

The work was done by the General Railway Signal Co., under O. W. DeWitt, general foreman.

Following Structural Steel Shop Details

		Structure			
Order No.		Location			
CONTRACTOR			ERECT.	EST. NO. CUST. NO.	
C. ADDRESS				TONNAGE	
ORDER REC'D		PLANS REC'D		SHIP	
ORDER COMPLT.		PLANS FILED		PLANS RETD.	
DRGS. APPL.				TIME S	
DRGS. APPRVD					
DRGS. MEAS.				TIME M	
DRGS. WEARD					
DETAILS HELD		DETLS. REL.		TOTAL COST	
LETTERS		DETLS. CONTR.			
SHOP	STRUCTURAL			CHECKER	
	STAIRS & PE			CHECKER	
	MISC & ORN			CHECKER	
REMARKS					

REVISION of a card for following structural steel shop details is offered by E. A. Goetz, of the St. Paul Foundry Co., St. Paul, Minn. It is for the use of the chief draftsman alone, and permits the following up of an order from the time it is received in the drafting department until a job is complete, when the card is filed. Referring to the card proper, and particularly to items "Time S" and "Time M," it should be explained that one group of men details the structural work on any order, while another group details the miscellaneous and ornamental ironwork. This immediately gives the cost on two classes of work which it is well to know even though they are ultimately applied to the cost of the whole job.

From Job and Office

Hints that Cut Cost and Time

Traveling Cranes Used to Reduce Cost of Handling Ties

RAILROADS and tie-treating companies are continuing to find that mechanical equipment can be used to advantage to do work about tie yards that has long been considered hand work. The special advantages of hammer-head type traveling cranes, Angiers loaders, and Davis tie tongs are noted in the report of the committee on material handling, presented at the recent meeting of the American Wood Preservers Association in Chicago. Special reference is made in the report to the new tie yard of the Oregon-Washington Railroad & Navigation Co. at The Dalles (see *Engineering News-Record*, May 22, 1924, p. 894). An abstract of this report is given below:

From the Oregon-Washington Railroad & Navigation Co. at The Dalles, Ore., comes news of what this committee thinks is the most economically operated tie-yard in the industry. This yard was laid out for the use of a 90-ft. hammer-head crane and the advantages of the layout and equipment are many. The gage of the crane track is about 22 ft. and the clearance is great enough for the crane to travel freely over railroad cars on the track through the center. The ties are unloaded by piece workers and stacked alongside the car in packages or unit cribs of 69 ties each; these are elevated by the crane, which piles them five packages high and eight packages or tie lengths back from the crane track. For removal of ties, the units are lifted by the crane and lowered alongside the narrow-gage track, where they are loaded on the trams by piece workers.

This installation requires the least amount of trackage, delivers ties eight lengths back from the track and tops out the piles 35 ties or about 25 ft. high. The crane handles a 5-ton load at a radius of 90 ft., lifts loads at 100 ft. per minute, travels the load along the boom at 150 feet per minute, can make one complete revolution in a minute and travels along the track at 200 ft. per minute. All four movements can be made simultaneously. The cost for labor and power in handling the units is less than 20 per cent of the rate per tie paid hand work in building the units or loading the tie trams.

Most tie yards have been laid out and enlarged for the primitive way of handling ties by man power or skids to a certain distance back and to a certain height. Where yard expansion has been impossible, operators have had to figure on piling higher, and here the locomotive crane is

From Job and Office

For Contractor and Engineer

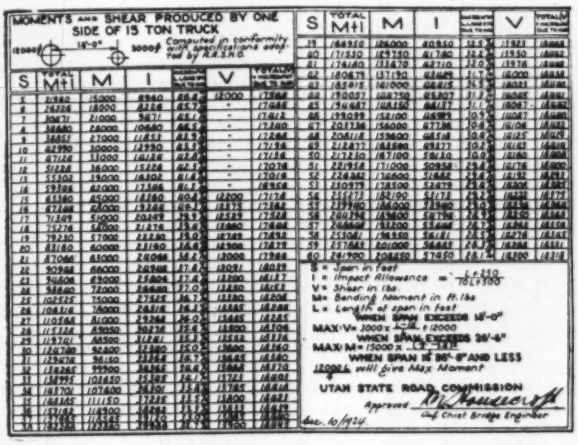
used by some, while others use stackers. Both methods, however, call for laborious effort before and after the machine functions. The locomotive crane is proving its worth in the handling of ties, while it is generally conceded that it is the most economical method of handling from trams to cars if open-top cars are available.

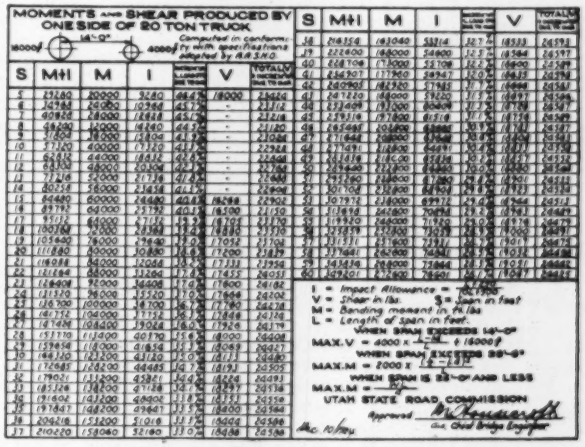
Some thought has been given the development of equipment that will cut the cost of handling, such as the Angier loader for loading ties from trams to covered cars, best operated by three men. A machine used by the Central Creosoting Co., at Findlay, Ohio, conveys the ties from the pile to any one of three trams and can be operated by five laborers. The Davis tie-tongs used with a 10-ton crane at the Southern Pacific Ry. plant at Houston, Texas, has a capacity of fourteen ties and is used for handling ties from yard to flat car and from car to clipping machine. The cost of handling is less than ½c. per tie. At normal cost also the ties can be cribbed outside a car door to be picked up and swung to a pile.

controlled pneumatically or electrically from elevated towers along the ladder tracks, each operator having a switching list to show the weight and destination of each car to guide him in controlling the speed.

The first brake is on the 4 per cent grade of the hump; others are upon the ladder track and the entering ends of the classification tracks. The brakes on the hump and ladders enable the operators to control the initial speed of the car at different points, instead of relying on the one brake in the classification track. It is stated that with this equipment the cars from the north hump of the yard were handled better and with more uniform spacing than when sixty-six car riders were employed, while the danger of personal injury to employees (especially at night and in winter service) was eliminated. With 105 car riders and switchmen the daily movement averaged 25 cars per man; but with 39 men (15 track-brake operators and 24 switchmen) the movement was 43 cars per man. Power-operated switches are proposed to reduce the number of switchmen.

Moments and Shear Produced by One Side of 15- and 20-Ton Trucks


MOMENTS AND SHEAR PRODUCED BY ONE SIDE OF 15 TON TRUCK
Computed in conformity with specifications adopted by A.S.H.O.
UTAH STATE ROAD COMMISSION
Approved
Chief Bridge Engineer


MOMENTS AND SHEAR PRODUCED BY ONE SIDE OF 20 TON TRUCK
Computed in conformity with specifications adopted by A.S.H.O.
UTAH STATE ROAD COMMISSION
Approved
Chief Bridge Engineer

THE tables herewith, showing moment and shear produced by one side of typical 20-ton truck and typical 15-ton truck, are computed in accordance with the specifications adopted by the American Association of State Highway Officials and as approved by the Secretary of Agriculture in Department Bulletin No. 1259 dated Oct. 9, 1924. They are submitted by M. Housecroft, who is acting chief bridge engineer of the Utah State Road Commission.

Track Brakes Control Railway Cars in Gravity Switching

A TRACK brake system now in experimental use at the gravity switching yard of the Indiana Harbor Belt R.R. at Gibson, Ind., has the special purpose of controlling the speed of cars running from the switching hump to the classification tracks, in order to eliminate the employment of car riders or brakemen and still prevent cars from coming together with such force as to damage equipment and freight.

Each brake consists of two or four bars (for one or both rails) 20 to 40 ft. long, parallel with the track rails and slightly above them, so that when pressed inward they will bear against the back and face of the car wheels. Parallel with the brake bar or rail and connected to it by nests of coiled springs is a heavy angle iron, these angle bars being connected together and to the operating mechanism. The setting and release of the brake is effected by pneumatic cylinders

An auxiliary device is a pneumatic apparatus for placing a sliding skid or skate on the rail to check a car moving too fast or too far along a classification track. These devices also are controlled from the brake towers. This track brake and skid placing system for controlling car movements in gravity yards is the invention of George Hannauer, vice-president, and E. M. Wilcox, master car builder, of the Indiana Harbor Belt R.R.

Foreign Yard Brakes—In principle the track brake described above resembles a system used in Germany, but applied only on the hump grade and the classification ladders. Here a vertical hydraulic cylinder between the rails operates the two inner braking rails by a vertical toggle action which causes the rails to engage the bottom of wheel flange and back of wheel; at the same time the outer brake is raised vertically so as to engage the face of the wheel. Power-operated skid brakes are also used in France, as described in *Engineering News-Record*, Oct. 9, 1924, p. 598.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The Lemniscate as a Transition Curve

Sir—The discussion on the lemniscate as transition curve prompts the writer to call attention to his paper on the True Transition Curve, *Engineering News-Record*, August 26, 1920. There is no excuse for the introduction of approximate curves when the true transition is admittedly the best riding curve, both for passenger comfort and for maintenance. The problems in connection with the use of this curve are completely solved by the methods outlined in the paper just quoted and the writer hopes, in the near future, to publish complete tables of what he termed the "transition functions."

The lemniscate is an intermediate approximation between the true transition and the cubic parabola. If the curvature is assumed to vary directly with the distance measured along the *tangent*, and an exact differential expression is used for the curvature, the equations of the lemniscate result. If, with the same approximations, the curvature is assumed to be given simply by the second derivative, then the cubic parabola results. For the true transition, there is the fundamental relation $\phi = \frac{k}{2} s^2$; for the lemniscate the corresponding relation is $\sin \phi = \frac{k}{2} x^2$.

New York City, Feb. 7, 1925.

GEORGE PAASWELL,
Consulting Engineer.

Precipitation and Runoff at the Continental Divide

Sir—In the excellent article on "Precipitation and Runoff at the Continental Divide," *Engineering News-Record*, Jan. 29, p. 190, the precipitation record called Longs Peak (p. 193) should be labeled Corona, as there is a so-called Longs Peak record at a much lower altitude. Had the authors, in discussing the runoff of Crystal River basin, used the 8-year precipitation record at Marble (El. 7,951) in that basin, with its mean value of 28.32 in., instead of the Ashcroft (El. 9,438) record, which has a mean value of only 20.67 in., the apparent excess of runoff over precipitation for the "Crystal River basin would have been reduced to less than 4 in. as the correct mean elevation of the basin is 10,900 ft. This excess is probably due to the fact that precipitation increases faster with elevation in this very wet area than was assumed by the authors from the meagre data available. That the excessive runoff of Fraser River and South Boulder Creek is entirely due to precipitation is shown by the precipitation records in these basins which lie on opposite sides of the Continental Divide with their crests touching:

Slope	Station	Elevation, Ft.	Mean Precipitation In.	Length of Record Years
W	Fraser	8,560	19.12	8
E	Longs Peak (near)	8,600	20.99	9
W	Spruce Lodge	9,600	30.13	6
E	Silver Lake	10,500	37.02	10
Crest	Corona	11,660	45.99	6

These records form a well-defined curve showing rate of increases in precipitation with elevation in both basins. From this curve the precipitation at the mean elevation of Fraser River basin is found to be 42 in. or 37 in. for the so-called "efficient for runoff," showing a loss of 11 in. The correct mean elevation of South Boulder Creek is 10,100 ft. and the corresponding efficient for runoff is 30 in., indicating a similar loss of 8 inches.

These corrections are designed to show that if care is taken to utilize precipitation records nearest the drainage basins whose runoff has been measured, the comparisons will show no apparent excess of runoff but, on the other hand, will show fairly consistent values representing losses by transpiration and evaporation by vegetation, and percolation of water not returning to the streams above the points of measurement.

Denver, Colo., Feb. 5, 1925.

ROBERT FOLLANSBEE,
District Engineer,
U. S. Geological Survey.

Railway Surveys from the Air

Sir—The entertaining style of the leading article in your issue of Feb. 5, the eminence of the author as a locating engineer, the romance of the story, the attractive cover design and prominent editorial "boost" have combined to give much weight to the conclusions set forth as to the efficacy of the aerial survey. Since the impression left with the reader is that the methods followed are the "last word" in the use of the airplane, Mr. Wicksteed's lack of enthusiasm moves the writer to mild protest in defence of the aerial method, which has been perfected far beyond the capacity to which it was there limited.

That topographic maps of extended areas can be made mechanically, by aerial photographic process, is now a matter of common knowledge to engineers. Happily, the writer can contribute first-hand testimony, that the results compare favorably in time, cost, and accuracy with old-fashioned preliminary surveys, through having recently completed the laying-out of a series of hydro-electric developments based on an aerial topographic map of some forty-odd miles of river valley, made by the Brock process. The detail surveys were for structures, tunnels, roads, pond calibrations and land lines, and were sufficiently extended to afford ample check on the accuracy of the map.

A number of your readers are, or have recently been, engaged in the Mexican, South American, or Alaskan theaters of railroad building activity. To us, the character of the terrain described in the article is not familiar, certainly not typical, and would seem to be peculiarly unsuited to aerial survey. Confusion also arises through the author's employment of the term "reconnaissance" to include continuous instrumental survey. The method familiar to most of us confines the use of the instrumental survey to that "narrow strip of country which will furnish a practicable line"; such strip being selected by reconnaissance with aneroid, clinometer, and compass, and conducted on horseback, afoot, or by canoe, if you choose. One is, therefore, startled to encounter the condemnation of the airplane as a reconnaissance instrument, because of its inability to run in curves or clear the right-of-way.

Gradient limits are set from the results of the reconnaissance, rather than arbitrarily fixed before investigation, and variation of a few minutes in vertical angle would not, in all cases, serve to eliminate an entire route from further consideration. It is impossible to determine ground elevations of wooded gaps by sighting from a canoe, or even from adjacent high, bold rocks, and one can easily conceive instances in which the relative elevations of the treetops, as such, would be most welcome information.

It is, however, in the field of instrumental preliminary survey that the writer claims marked superiority for the aerial method. The mechanical process is theoretically and practically sound. Variations in vertical and horizontal scale, due to dipping, weaving, or banking of the plane, are corrected. Minimum ground control work is necessary. Maps can be completed in progressive sections, as desired, and are in the hands of the engineers for study in a fraction of the time required for ground surveys. While it is true that large areas of unbroken woods are serious obstacles to close aerial work, inaccessible places such as cliffs, marshes, desert spaces or bodies of water, are all one to the aerial camera.

Like Mr. Wicksteed, the writer confesses to the possession of an untrained eye for horizontal relief, but demonstrations of greater familiarity with aerial perspective on the part of others has convinced him that the fault lies partly in his many years' enforced reading of the horizon from *terra firma*. Some of us can remember the valiant stand of the Old Guard against "paper location," at the time when methods of the late '70s were being supplanted by the progress of scientific location. With history about to repeat itself, the question is whether the "writing on the sky" is for us, as well as for our methods.

H. R. FAISON,
Field Engineer, Mees & Mees; formerly locating Engineer, National Railways of Mexico.
Hendersonville, N. C., Feb. 11, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Committee on St. Paul Cathedral Safety Makes Report

London Correspondent

The committee of experts appointed to report on the measures necessary to insure the future safety of St. Paul's Cathedral, London, consisting of Sir Aston Webb, Basil Mott, E. C. Trench, G. W. Humphreys and Mervyn E. Macartney, have concluded their investigations. The city of London surveyor had reported that it would be necessary to remove the dome and to rebuild entirely the eight piers supporting it. The committee does not believe such a course to be either advisable or necessary, and its recommendations are:

1. To consolidate the piers by grouting through bore holes and by strengthening the piers temporarily with steel and timber casing during the process, and by reinforcing the piers with metal rods embedded in the bore holes, to be followed by replacement of any defective ashlar.

2. To encircle the drums of the dome with metal hooping to check any possible cumulative increase in circumference of this fabric. (The dome shows a tendency to "spread.")

3. To repeat at six-month intervals the series of leveling observations, and also plumbing and other measurements.

4. To guard against danger accruing from building operations in the immediate vicinity and below the level of the foundations of the cathedral.

This report is being considered by the Representative Committee for the Preservation of St. Paul's Cathedral.

To Appraise Reclamation Projects in Two Groups

Reappraisal of the federal reclamation projects by direction of Secretary Work of the Department of the Interior, is to be carried out by two sections of the board recently appointed for the work. One section of the board, headed by ex-governor Thomas E. Campbell of Arizona, will review the Rio Grande, Carlsbad, Grand Valley, Belle Fourche, Okanogan, Yakima, and Klamath projects, while another section, headed by Dr. John A. Widtsoe, of Salt Lake City, will review the Boise, Minidoka, King Hill, Umatilla, Huntley, Lower Yellowstone, Milk River, and Sun River projects. This work will be carried out between now and the end of May. During April the full board will survey the Uncompahgre, North Platte, and Shoshone projects, and in June the Newlands project. A period of four to ten days has been allotted to each project in the itinerary laid out for the board.

No review is to be made of the Orland, Salt River, Yuma, Strawberry Valley, Riverton, and the Williston projects.

Engineering Fifty Years Ago

From *Engineering News*, March, 1875

IT would seem as if the days of iron rails were numbered. Railroads that can afford it — and the difference in price between fair iron rails and bessemer steel is now but little — will hereafter re-lay their track with steel, which has proven so much more economical. Roads with light traffic, and those that financial condition compels so to do, will use iron still, but even on these it will probably be found full as cheap in first cost to use a light steel rail, and much the cheapest in the end. And yet a *good* iron rail has more wear in it than is generally supposed.

Pennsylvania R.R. Wins in Suit With Labor Unions

The U. S. Supreme Court, in a decision in two cases brought by labor unions, sustained the Pennsylvania R.R. Co. in a position which it has maintained, even in the face of adverse rulings by the Railroad Labor Board, namely, that the representatives of its employees in labor disputes must be chosen from among the company's employees, that the company has a right to deal directly with its employees as such and not as members of specific labor organizations.

The decision is considered as reducing the powers of the Railroad Labor Board as the board had previously ordered the Pennsylvania to deal with whomever the employees might elect. The court in its decision stated that there was nothing in the Transportation Act to indicate that Congress intended to force the railroads or their employees to comply with decisions of the board.

Chicago Passes Ordinance to Buy Street Railways

By a record vote of 40 to 5 the Chicago city council on Feb. 27 adopted the municipal railway ordinance proposed by Mayor Dever, under which the city will acquire the existing surface and elevated lines and build subways and extensions, payment to be made by "certificates" which are payable solely out of the earnings of the property and not from taxation. After much controversy over this system of payment it was approved by a number of banking firms.

The project now has to pass the test of a public referendum vote to be held on April 7.

Concrete Institute Holds 21st Annual Meeting

Few Specifications Considered — Concrete Proportioning and Formwork Subjects Most Emphasized

At its 21st annual meeting, held at Chicago, Feb. 24-27, the American Concrete Institute had an attendance greater than any other except possibly that of last year when special interest was attracted by the 20th anniversary sessions. This year's convention comprised eight sessions, at one of which there were simultaneous meetings in adjoining rooms covering the not altogether related subjects of concrete products and structural concrete. In addition, one evening was given over to a banquet.

In contradistinction to previous years, the specifications of the Institute came in for little discussion. Seventeen committees reported, but only seven of them reported specifications, the other ten submitting reports mainly indicating progress. None of the seven committees submitted any new specifications. Practically all of the specification recommendations were for advancing tentative specifications to standards, and the withdrawal of old specifications which had been duplicated. The tentative standards passed to letter ballot for standard were those for concrete pavements for streets and highways, concrete sidewalks, building block, concrete tile and concrete brick. Tentative standards revised included those for drain tile and sewer pipe, concrete floors, the treatment of exterior surfaces, and expansion joints.

Committee Reports

Committee S-5, on Concrete Houses, submitted a proposed recommended practice for the design and construction of concrete dwelling houses, which was criticised, largely by different members of the Joint Committee, as to the details of concrete design, which were stated to be too conservative. The committee defended its report on the ground that conservatism was necessary in a small house design and construction and that the rules applying to general concrete work might be radically dangerous in this type of work. The report was accepted. Committee S-1, on Reinforced-Concrete Chimneys, submitted for the second or third year a preliminary report on recommended practice for the design of reinforced-concrete chimneys and proposed tentative specifications for the construction of reinforced-concrete chimneys. Both of these brought forth considerable opposition from the floor, mainly on the ground that they were inadequate and incomplete. The committee, through its representatives, expressed some disturbance at the general nature of the

criticism and stated that it had repeatedly had its work so criticised in prior years. It requested specific data wherein it might elaborate and improve its recommendations. These data, however, were not forthcoming in any great amount. As a result of the discussion, the report of the committee with its two proposals was voted back to the committee with recommendation that it reconsider the subject.

Committee E-6, on Destructive Agents and Protective Treatment, submitted a report consisting mainly of photographs of various examples of defective concrete with comments upon the causes in the particular cases, which were not located by name or place. The examples selected indicated, according to the committee, the importance of porosity, and the durability of concrete. The damage to the structure is in proportion to the freedom with which water enters and passes through the concrete. The committee directed attention to the causes of porosity in concrete, as an understanding of these causes points the way to their elimination. Porous concrete in the structures covered by this study resulted from one of the following, according to the report: (1) Excessive mixing water, (2) deficiency in cement, (3) dirt or excess of fine material in the aggregate, (4) segregation of materials in handling and placing the freshly mixed concrete. Of these, excess mixing water is found to be by far the most important as well as the most common. The report then proceeded to demonstrate that practically all of the trouble in the illustrations shown is due to overwet mixing. As a final result of its preliminary investigation the committee states that durable concrete, that is impervious concrete, involves no mystery. The requirements are clean aggregate from durable minerals, a mixture of a fair degree of richness, the use of a puddling consistency, and care in placing and curing.

Open Discussion

In the floor discussion there was some objection to the simplicity of this explanation of disintegrated concrete and a warning not to assume that all defective concrete is due to excess water or that excess water is the only thing that will cause defective concrete, but the committee representatives admitted that this was only one phase of the investigation that the committee is making and that it would be wrong to make any such assumption.

The representation of the American Concrete Institute on the Joint Committee on Concrete and Reinforced-Concrete reported formally the adoption of the report of the Joint Committee by the five constituent societies. This brought the committee report before the convention for discussion and resulted in a rather lengthy critical analysis of the report by one or two members. The objections to the report were based mainly on its design provisions, particularly on the new method of column analysis and on the theory of the flat slab adopted. As a part of this same discussion was the discussion of the report of Committee E-1 which is to prepare a building code for concrete and which, according to its chairman, will submit a code based on the principles of the Joint Committee report. This year the committee presented merely its general prospectus and stated that the code would be circulated among the members before the coming summer, with the hope of getting such criticisms that the committee next fall might prepare a complete code for submission to the convention next winter.

Committee E-5, on Aggregate, noted that it was continuing in its attempt to solve the problem of providing the Institute with specifications on aggregate. It reviewed the provisions of the Joint Committee on aggregate and approved them in the main with some exceptions, particularly in the matter requesting the inclusion of slag as a proper aggregate. Committee S-6, on Roads and Pavements, refused to include rerolled steel in its specifications on the ground that such steel was too hard and too non-uniform, its carbon content being so high. They, therefore, stuck to their old recommendations which exclude rerolled steel although they were requested last year to reconsider this provision.

Committee E-4, on Fire Resistance of Concrete, in a progress report, elaborated some of the better known properties of aggregate in its rôle as a fire resistant. That is, it condemned silicious aggregates, said that cinder transmits heat readily, that slag makes good aggregate for fire resistance, and that limestone is the most superior of all in this quality. The report was a progress one only.

The majority of the papers were on concrete mixing and proportioning. The first of these was by T. P. Watson, assistant engineer of the Pennsylvania R.R., and described the operations of the Becks Run bridge near Pittsburgh, operations which were described in *Engineering News-Record*, Jan. 29, p. 184. A. W. Munsell, assistant engineer, Delaware River bridge, told about the field control of concrete on that bridge. W. K. Hatt, professor of civil engineering, Purdue University, described the methods which were adopted to instruct foremen in the proper control of concrete on the Purdue University stadium last summer. Finally, C. P. Richardson, engineer of track elevation of the Rock Island, read a general paper advocating closer attention to the theory of concrete mixing and placing as a means of bettering practice. G. W. Hutchinson, lately of the North Carolina Highway Department, presented a series of tests as a result of the study of which it is recommended that concrete should be proportioned with a given amount of cement in volumetric ratio to the finished concrete. Tests were made with special reference to highway work with a number of impact tests included. According to the author, the indications of the tests are that it is logical and economic to depart from the universal application of single theory proportioning of concrete for all purposes and greater economy may be secured by considering the type of structure when designing the concrete mixture.

Along the same line was a paper by A. A. Levison, chief engineer of the Road Department of the Blaw-Knox Co., on a new device incorporating the so-called Bertin inundator to a concrete measuring and mixing plant. Mr. Bertin, chief engineer of the White Construction Co., New York City, two years ago suggested the possibility of taking care of the bulking of wet sand and the consequent disturbance of the balance of the concrete mix by completely inundating all sand prior to its placing in the concrete mixture. He devised a rough machine for this purpose which has been gradually improved and which is now being put on the market as a complete attachment to concrete mixing plants. Mr. Levison described the details of its operation.

Discussions on Cement

The subject of cement came in for discussion in several papers. Thaddeus Merriman, chief engineer of the Board of Water Supply of New York City, presented a rather novel paper, entitled "Concrete From the Viewpoint of Mr. Cement," in which cement was personified and charged with many of the shortcomings of concrete. Mr. Merriman, in effect, put him on the witness stand to testify in his own defense. The major contentions of the paper were that fine grinding as developed today undoubtedly gives high strength at early periods, but quite possibly is the cause of a lesser strength at long periods and of durability and that compressive strength of the concrete continues to increase possibly, but adherence between the particles of the concrete, that is, the internal tension, does not increase but keeps the same. It was the general contention of Mr. Merriman's paper that the whole make-up of cement and its method of manufacture might be worthy subjects for further investigation. A paper on laitance was presented by R. M. Miller. The conclusions of the author are that in placing concrete in sea water particularly the greatest care must be taken to protect the plastic mass of the concrete from the action of the water during placing. It is suggested, however, that retempering the concrete may be of advantage in the elimination of laitance.

P. H. Bates, chairman of the newly formed committee on crazing, presented an individual report, outlining the prospects of the committee's work. Mr. Bates said that crazing is no simple problem to be solved by field examination, followed by more or less perfunctory laboratory research. It requires the active service of several trained investigators and he felt that no very great progress would be made by any committee until it had a certain amount of funds at its disposal to make needed studies. Crazing is universally present in concrete work, he said. Indeed, it is present in all ceramics. Anything of a nature that sets with a skin or surface tends to craze. The study of what causes this crazing is very complicated. Maximilian Toch, of Toch Bros., presented a paper calling attention to the difficulties in the use of certain kinds of coloring material in concrete.

Structural papers included one by

(Continued on p. 413)

San Fernando Wells Supplement Los Angeles Aqueduct Flow

Irrigation has been carried on in San Fernando valley with water from the Los Angeles aqueduct since 1915 and in recent years the water table has been continually rising in the valley. Because rainfall has been below normal for some years and water demands have rapidly increased, it has recently been decided to draw on this underground water as a source for supplementing the aqueduct flow. Accordingly eleven wells have been put down and four more are to be sunk. These wells are yielding an average flow of 5 sec.-ft. each.

The water is found to be of excellent quality and can be put into the aqueduct supply mains or into Weid Canyon reservoir as desired. For the present it is used chiefly for irrigation in the immediate vicinity of the wells.

In the lower parts of the valley the ground water level had risen practically to the surface but tests in that vicinity showed the rate of infiltration into wells there to be less than in the center of the valley. The latter location was therefore selected for the wells, despite the greater pumping cost, in order to get greater quantities.

Remove Obstacles to Building of 375-Ft. Pacoima Dam

The removal of federal and state objections have cleared the way for active construction on the Pacoima dam in southern California, one of the several structures proposed by the Los Angeles County Flood Control District. Bent Bros., the contractors, have had small crews doing preliminary and preparatory work for some time; larger crews are now being put on and it is expected that in March construction will be well under way on the project as a whole. The contract calls for completion in three years but the contractors expect to organize their forces so as to finish the work in less time.

This dam will be the constant-angle arch type and will have a total height of 375 ft. above stream bed with a crest length of 600 ft. It will contain about 160,000 cu.yd. of concrete and will develop a storage capacity of 12,000 acre-ft.

Advantages of Railway Electrification on St. Paul Road Shown

Comparative Cost of Steam and Electric Operation on 650 Miles of Railway Made Public by Chicago, Milwaukee & St. Paul Ry. Co.

Figures comparing the cost of steam and electric operation on three divisions of the Chicago, Milwaukee & St. Paul Ry. have been prepared by the company in order to determine the economic advantages of electric over steam operation. These computations were made public last week. They are based on all the determinable costs involved in both methods of operation and do not take into consideration the incidental advantages of electric operation which cannot be accurately valued. As the C., M. & St. P. Ry.'s electrified divisions have a combined length of main line track of 648 miles upon which all operations—freight, passenger and switching—are performed by electricity, they make up the largest unit of electric operation ever undertaken and consequently these figures are of unusual interest.

The divisions under consideration consist of two adjoining divisions, the Rocky Mountain and Missoula, upon which electric operation began in 1916, and the Coast division, upon which electric operation began in 1920. The Idaho division, lying between the Missoula and Coast divisions, is not electrified.

Direct-current, overhead-trolley type electrification is used. Purchase current is delivered to the substations from the company's high-tension transmission line where it is stepped down from 3-phase a.c. at 100,000 volts to 2,300 volts and converted through motor generators to direct current at 3,000 volts for the trolleys. The locomotives have regenerative braking.

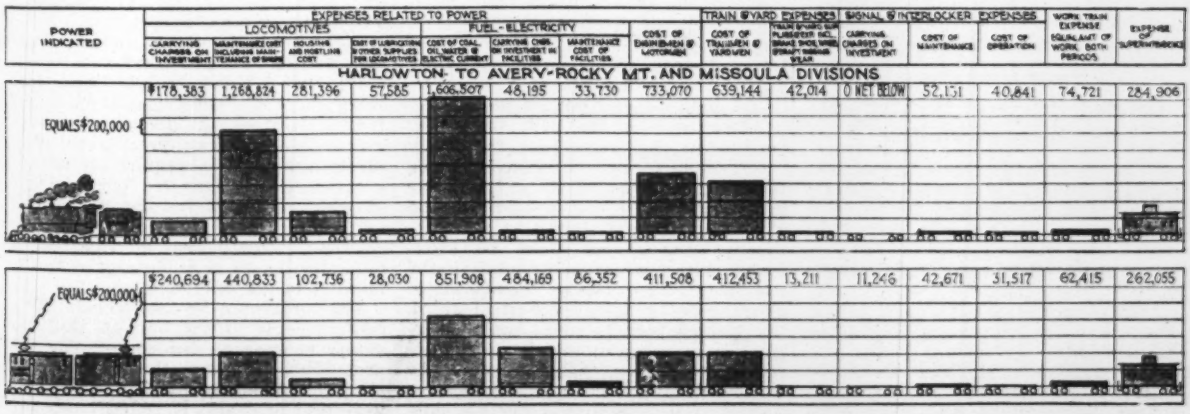
In the preparation of the report the Rocky Mountain and Missoula divisions are considered as a unit because the density of traffic on them is about the same. Figures for the Coast division where the traffic is less were prepared separately. Actual figures for the cost of electric operation for the year 1923 are used and the comparative figures for steam are based upon the actual costs for the last year of steam operation on each division, adjusted to the 1923 level by figures for the cost of steam operation on divisions so operated in 1923. Tonnage adjustments also have been made.

The accompanying table gives the net saving from electric operation for the years since the beginning of electric operation. From this it will be noted that for the year of minimum tonnage, 1921, the net saving was $671,000, and also that had the Coast division been in operation in the year of maximum tonnage, 1919, the net saving would have been $2,355,200.

SAVING BY ELECTRIFICATION: CHICAGO, MILWAUKEE AND ST. PAUL RY.

	Mountain and Missoula Divisions Harlowton to Avery Electrical operation began April and Nov., 1916		Coast Division Othello to Tacoma Electrical operation began March, 1920		All Electrified Sections	
Years	Volume of traffic-gross ton-miles frt. and pass.	Net savings by electrification	Volume of traffic-gross ton-miles frt. and pass.	Net savings by electrification	Volume of traffic-gross ton-miles frt. and pass.	Net savings by electrification
1916	†1,639,054,000	†$1,098,166	.....	.....	1,639,054,000	$1,098,166
1917	2,677,097,000	1,641,369	.....	.....	2,677,097,000	1,641,369
1918	2,759,178,000	1,734,687	.....	.....	2,759,178,000	1,734,687
1919	2,894,063,000	1,888,037	.....	.....	2,894,063,000	1,888,037
1920	2,710,745,000	1,679,623	*691,674,000	*$249,003	3,402,419,000	1,928,626
1921	1,812,714,000	658,651	664,238,000	12,363	2,476,952,000	671,014
1922	2,109,868,000	996,485	734,121,000	103,301	2,843,989,000	1,099,786
1923	2,247,102,000	1,152,508	746,405,000	119,285	2,993,507,000	1,271,793
1924	2,129,426,000	1,018,721	691,476,000	47,808	2,820,902,000	1,066,529
Total		$11,868,247		$531,760		$12,400,007

†Tonnage and savings for 6½ months.
*Tonnage and savings for 9 months.


POWER INDICATED
EXPENSES RELATED TO POWER
LOCOMOTIVES
FUEL - ELECTRICITY
TRAIN & YARD EXPENSES
SIGNAL & INTERLOCKER EXPENSES
WORK TRAIN EXPENSE
EXPENSE OF SUPERINTENDENCE
CARRYING CHARGES ON INVESTMENT
MAINTENANCE COST INCLUDING MAINTENANCE OF BRAKE
HOUSING AND HOSTLING COST
COST OF LUBRICATING & OTHER SUPPLIES FOR LOCOMOTIVES
COST OF COAL, OIL, WATER & ELECTRIC CURRENT
CARRYING CHGS. ON INVESTMENT IN FACILITIES
MAINTENANCE COST OF FACILITIES
COST OF ENGINEMEN & MOTORMEN
COST OF TRAINMEN & YARDMEN
TRAIN SUPPLIES INCL. PLANTATION INCL. BRAKE SHOE WEAR, STEAM FOR HEATING TRAINS
CARRYING CHARGES ON INVESTMENT
COST OF MAINTENANCE
COST OF OPERATION
EQUAL AMT. OF WORK, BOTH PERIODS
HARLOWTON TO AVERY-ROCKY MT. AND MISSOULA DIVISIONS
EQUALS $200,000
$178,383 1,268,824 281,396 57,585 1,606,507 48,195 33,730 733,070 639,144 42,014 0 NET BELOW 52,151 40,841 74,721 284,906
EQUALS $200,000
$240,694 440,833 102,736 28,030 851,908 484,169 86,352 411,508 412,453 13,211 11,246 42,671 31,517 62,415 262,055

GRAPHICAL REPRESENTATION OF DIFFERENCES IN COST OF STEAM AND ELECTRIC RAILWAY OPERATION

North Atlantic States Hold Highway Conference

With about a thousand members pledged since its organization in January, the Association of Highway Officials of the North Atlantic States met in its first convention in Atlantic City, N. J., Feb. 25-27. Including exhibitors' representatives and guests, nearly a thousand were in attendance and all of the six sessions of the three-days meeting were crowded. The papers were as follows:

"State Highway Departments—Their Organization, Duties and Responsibilities," by W. M. Acheson, division engineer, Bureau of Highways, Syracuse, N. Y.; "Traffic and Its Effect on Highway Maintenance," by Paul D. Sargent, chief engineer, Department of Highways, Augusta, Maine; "Development of New Arterial Highways for Handling Traffic in Congested Areas," by Fred Lavis, assistant construction engineer, State Highway Department, Trenton, N. J.; "Factors Affecting Efficiency in Construction Organization and the Influence of Specification Interpretation on Unit Cost," by T. J. Wasser, chief engineer, Public Service Production Co., Newark, N. J.; "Arlington Tests on Subgrade Treatment and Their Relation to Rigid and Non-Rigid Type Pavements," and "Conclusion Drawn from the Arlington Service Tests and Their Relation to Pavement Design," by A. T. Goldbeck, chief engineer, Division of Tests, U. S. Bureau of Public Roads, Washington, D. C.; "A Comparison of the Illinois Section with Typical Sections of the Eastern States," by H. E. Breed, consulting engineer, New York City; "Factors Determining the Necessity and Methods of Reconstruction," by W. H. Connell, engineering executive, State Highway Department, Harrisburg, Pa.; "Trend in Bituminous Pavement Design for Heavy Traffic," by Prevost Hubbard, Asphalt Association, New York; "Late Developments in the Design and Maintenance of Bituminous Macadam Pavements," by J. S. Crandall, The Barrett Co., New York; "Economic Value of Grade and Alignment on Heavily Travelled Roads," by E. W. James, chief, division of design, U. S. Bureau of Public Roads, Washington, D. C.

The officers of the association are: William G. Sloan, Trenton, N. J., president; Paul D. Sargent, Augusta, Maine, vice-president; and A. Lee Grover, Trenton, N. J., secretary and treasurer.

Colorado River to Be Studied by Senate Committee

A resolution has been passed authorizing the Senate committee on Irrigation and Reclamation "to make a complete investigation with respect to proposed legislation relating to the protection and development of the Colorado Basin." The committee, or any subcommittee thereof, is authorized to hold hearings at any point within the United States prior to the opening of the first regular session of the next Congress. Senator McNary of Oregon is the chairman of the committee and will preside at the hearings.

Arlington Bridge Bill Signed by Coolidge

After having considered the project for seventy-five years Congress finally has authorized the Arlington memorial bridge, which is to span the Potomac at Washington. The President has signed the bill. The bridge will cross the Potomac at a point so as to make a direct connection between the north bank at the Lincoln Memorial and the south bank near the old Lee Mansion. The bill authorizes $14,750,000 for the project, which is to be completed within ten years.

Kansas City Asks Bids on Garbage and Refuse Service

Bids for the collection and disposal of the garbage and rubbish of Kansas City, Mo., for a period of ten years will be received by the Hospital and Health Board at 10 a.m., March 10. Bidders must furnish all necessary plans, equipment, buildings, sidings, land labor, horses and appurtenances; must make their own determination of local conditions as to sites for disposal plants probable quantities of garbage and rubbish, available methods of disposal, and must consult a preliminary report on these subjects made in February, 1925, by Pearse, Greeley & Hansen, consulting engineers, Chicago; and may have access to all pertinent information in the possession of the Health and Hospital Board but the city does not guarantee the correctness of any such information.

Bonding Conference Demands Surety Bond Reform

A conference representing various branches of the construction industry, held in Washington on Feb. 16, passed resolutions condemning current practices in contract surety bonds and calling for certain reforms. The conference had representative members from the Associated General Contractors of America, the American Institute of Consulting Engineers, the American Society of Civil Engineers, the American Institute of Architects, the American Society of Mechanical Engineers, the American Society for Municipal Improvements, and from the nationally organized manufacturers of construction equipment and materials.

After reciting the evils of surety bonding as they have been frequently described in recent conferences, it was recommended that, first, a legislative investigation into the present method of contract bond underwriting be undertaken; second, that there be introduced state legislation prohibiting the use of certified checks furnished or guaranteed by an underwriter; third, that private owners adopt bankable securities in competition with corporate securities; fourth, that contractors be requested to fill out a comprehensive uniform questionnaire covering skill, integrity and responsibility before bidding on construction work (a copy of this questionnaire accompanies the resolution); fifth, that agents of corporate surety companies be denied the authority to bond their companies for unlimited amounts; sixth, that surety company agents be compensated by some other method than which takes into consideration merely the process of underwriting; seventh, that the surety companies "enter into an agreement to place the collection of information, verification of experience, character and performance records, financial statements and all other essential information in the hands of some agency which does not participate in premiums and refuse any re-insurance to any bonding company refusing to co-operate in such a procedure"; eighth, that legislation be enacted making it unlawful for any government official directly or indirectly to benefit from the writing of an insurance bond; ninth, that a clause be introduced into every corporate surety bond providing for arbitration of disputes between owner and underwriters; tenth, that surety companies be required to submit a standard questionnaire (copy of one of which accompanies the resolution) as to their integrity as corporate securities; eleventh, that all free service by underwriters to bidders prior to the filing of bonds be eliminated.

The conference further added: "This conference is of the opinion that the surety companies can correct the improper practices admitted to exist and that the members of this conference urge that measures be immediately put into practice to correct these abuses."

Ontario Hydro Plans New Plant

The Hydro-Electric Power Commission of Ontario has in preparation plans for the construction of a dam at Virgin Falls, the outlet of Lake Nipigon, to develop power and provide storage by raising the level of the lake about 5 ft. above its present stage. It is expected that it will take five years from the time of the completion of the dam to raise the lake to the new level. The lake is 90 miles long and 50 miles wide.

Columbia Basin Report Believed Not Complete

Washington Correspondence

Comment in official circles on the engineering report on the Columbia Basin irrigation project (p. 400 of this issue) indicates that the report is unsatisfactory in certain respects. The report is incomplete to the extent that it does not indicate the average cost per acre. No estimate is made as to the number of farms, the cost of the land, or the cost of farm development. Such estimates are held to be just as necessary as data in regard to engineering costs. The consensus of opinion seems to be that additional data must be submited before any conclusion can be reached as to the feasibility of the project. If the cost of construction alone is to be $300,000,000 and interest is to be at 6 per cent, interest and taxes alone will account for $10 per acre from the very beginning and will accumulate during settlement.

Concrete Institute Meeting

(*Concluded from p. 410*)

H. A. Ward, of the Turner Construction Company, on the design of reinforced-concrete circular bins for the storage of cement; E. A. Dockstader, of Stone & Webster, on tests made to determine the temperature of reinforced-concrete chimney shells. This latter paper was of particular interest to the Committee on Reinforced-Concrete Chimneys, especially as there had not been available before very much information on temperature transmission through the concrete shell of the chimney. In this test of a chimney Mr. Dockstader found that the maximum drop in temperature of the shell, where it was unlined, was 20 deg. F. per inch of shell, and where lined 10 deg. F. per inch of shell. This applies, of course, only for the particular type of chimney tested.

An admirable set of papers on the details of concrete formwork formed the beginning of the question box on concrete construction work. The remainder of the question box did not develop as much novel material as did the similar question box last year. In the simultaneous section on concrete products however, a more lively discussion was developed.

The officers of the Institute were re-elected for the ensuing year. They are: President, A. E. Lindau, of the American System of Reinforcing, Chicago; vice-presidents, E. D. Boyer, Atlas Portland Cement Co., M. M. Upson, Raymond Concrete Pile Co., both of New York City; secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. It was announced that the membership of the society was increasing very rapidly, there being at the time of the convention some 1,540 members as compared to 425 members members four years ago.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

The Florida Engineering Society will hold its annual meeting at West Palm Beach March 9 and 10; some of the papers will be: "Zoning in the Everglades," "Use of Pumps in Everglade Subdistricts," "Building of the Florida Western & Northern Ry.," "Progress of Mosquito Control in Florida," and "Use of Engineer Service Agreements."

The Cleveland, Ohio, Engineering Society will hold a conference on building design and construction March 10 at the Hotel Winton. Papers include "Foundations," by Daniel E. Moran, president, Moran, Maurice & Proctor, foundation engineers, New York City; "Floor Construction and Surfaces," by G. G. Greulich, of The Rivet Grip & Steel Co., Cleveland; "Mechanical Equipment of Building," by I. H. Francis, consulting engineer, Philadelphia; "Legal Pitfalls in the Building Industry," by Clinton H. Blake, attorney, New York City; and "Waterproofing," by Harry Gillett, Gillett Asbestos Co.

The Western Society of Engineers schedules the following meetings during March: March 10, "The New Illinois Central Terminal" by D. J. Brumley, chief engineer, Chicago Terminal Improvements; March 17, "Some Engineering Features of a Modern Gas Plant" by H. E. Bates, assistant chief engineer, Peoples Gas Light & Coke Co.; March 24, "The Mercury-Vapor Boiler and Turbine" by W. L. R. Emmett, consulting engineer, General Electric Co.; March 30, "Construction of the White River Bridge, Chicago, Rock Island & Pacific R.R.," by A. S. Armstrong, superintendent, Bates & Rogers Construction Co. The Young Men's Forum will visit a creamery March 7 and hear Samuel Insull, Jr., March 25.

The Engineers Society of Milwaukee at a special meeting March 6 will be addressed by T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission on "Water Diversion at Chicago." Owing to the criticisms of the position of Mr. Hatton on the board of experts and of the report, Mr. Hatton asked for an opportunity to present his side of the case.

The New England Water Works Association at its March 10 meeting will have three discussions on the diesel engine as follows: "The Diesel Engine and Its Overall Efficiency," by C. B. Jahnke, chief engineer, Fairbanks, Morse & Co.; "Diesel Engine Experience in a Pumping Plant," by Leonard C. L. Smith, consulting engineer, Long Island City; and "Diesel Engine Experience in a Modern Forge Plant," by J. P. Harbeson, Jr., chief engineer, Camden Forge Co., Camden, N. J.

Personal Notes

HUGH A. BROWN of the Washington staff of the Reclamation Bureau, in addition to his duties as editor of the *Reclamation Era*, will serve as the head of the division of Reclamation, Economy and Settlement.

CAPT. HUGH CRAWFORD, formerly city engineer of Independence, Kan., and more recently sales engineer with the Texas Co., at Des Moines, Iowa, has become associated with Charles A. Haskins in civil and sanitary engineering at Kansas City, Mo.

JOHN E. GOODWIN, of Augusta, Maine, acting chief engineer of the Public Utilities Commission of the state of Maine since the resignation of WILLIAM M. BLACK a year ago, has now assumed his duties as inspector of dams and reservoirs of the state.

C. D. JOHNSON has been appointed division engineer for the Denver & Rio Grande R.R., with headquarters at Alamosa, Colo.

R. C. HARDMAN has resigned his position as assistant chief engineer of the Central Highway Board of the Republic of Panama to become chief engineer for R. W. Hebard & Co., Inc., and René Keilhauer, who have a contract for the design and construction of complete sanitation works in the city of San Salvador, Salvador. The work includes street paving, storm and sanitary sewers, water-works, etc., with the possible future installation of a water-purification plant and a sewage-disposal plant.

C. F. HOSTRUP, recently manager of Water Waste Surveys for the Pitometer Co., of New York, has joined the forces of J. G. Thorne, of Clinton, Iowa; the new organization will be known as Thorne & Hostrup and will specialize in the design and construction of municipal improvements.

ROBERT A. MACGREGOR, of the public works department of the Borough of Manhattan, New York City, has been appointed engineer of maintenance of pavements and sewers of the Borough of Manhattan. Mr. MacGregor has been an assistant engineer in the Manhattan department of highways for thirteen years and previously held the same position in the Borough of the Bronx for many years.

LOUIS MITCHELL, dean of and professor of civil engineering in the L. C. Smith College of Applied Science, Syracuse University, has been appointed a member of the grade crossing commission of the city of Syracuse, to succeed ALEXANDER T. BROWN, who at the time of his resignation recently was chairman of the commission.

A. C. SHIELDS, engineer of maintenance-of-way of the Denver & Rio Grande Western R.R., Denver, Colo., has been named assistant general manager and will have general supervision over maintenance-of-way and structures.

IRVING C. BROWER, former city manager of Pontiac, Mich., has been appointed city manager of Lima, Ohio. Mr. Brower has been in municipal work for more than eight years, five in Evanston, Ill., and the rest in Pontiac. He is vice-president of the National City Managers' Association.

S. J. BOONE, assistant engineer of maintenance for the Kentucky Highway Department, has resigned. C. W. LOVELL has been promoted from assistant district engineer to district engineer of the second district, with headquarters at Bowling Green, Ky.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Mixer Manufacturers Bureau Discusses Standards

Owing to apparent conflict in state regulations regarding the batch load of the 21-E paver, the Mixer Manufacturers Bureau, affiliated with the Associated General Contractors of America, decided at its meeting in Chicago Feb. 20 that the A. G. C. should send a questionnaire to its highway members to determine the proper rating of this size of concrete mixer.

Under the standards adopted for concrete mixers, either a 5-bag or 6-bag mix can be used in the 21-E paver, according to the mix desired. Some state highway departments, however, have regulations forbidding more than a 5-bag mix in this size.

The question of the standard sizes adopted by the bureau was gone over fully at the Chicago meeting and a report by the technical committee dealing with repair parts was received. It was decided that the standardization program shall not apply to mixers made in Canada.

The bureau decided that No. 4 mixers may be advertised in literature until present stocks are exhausted, but shall not be advertised further in the engineering and trade papers. It also was decided to eliminate the item of capacity in unmixed materials from price books issued in the future. No reports will be submitted hereafter of sales of anything below 3½-cu.ft. size, as the small mixers are not standard and are offered only until stocks are exhausted.

The bureau determined to increase the price of nameplates of the A. G. C. used on standard mixers to designate approved standards, and to make the increase retroactive, in order to raise additional funds for support of the bureau.

Equipment Distributors Elect

At its annual meeting held in Milwaukee during the first week of January, the Associated Equipment Distributors elected the following officers: President and secretary, M. R. Hunter, Hunter Machinery Co., Milwaukee; first vice-president, William H. Ziegler, Wm. H. Ziegler Co., Inc., Minneapolis; second vice-president, A. C. Blaisdell, Queen City Supply Co., Cincinnati; treasurer, W. B. Louer, W. B. Louer Co., Chicago.

Directors elected for a three-year term were Fred Mattheis, Hedge & Mattheis Co., Boston, and George F. Smith, George F. Smith Co., St. Louis. Directors chosen for a two-year term were L. N. Cleveland, Concrete Machinery & Supply Co., Los Angeles; H. W. Fletcher, Clyde Co., New Orleans, and K. B. Noble, K. B. Noble Co., Hartford, Conn. For the term of one year, E. Yancey, Yancey Bros., Atlanta, Ga., was elected.

Trench Pump Data Tabulated by A. G. C.

Replies to inquiries made by the Associated General Contractors among constructors in connection with the average life of a trench pump have been tabulated to supplement information held for other types of equipment by the A. G. C. equipment schedule.

These replies show that the average life of a trench pump is somewhat shorter than that of a piston pump and that the item of repairs runs a little higher.

The following tabulation would seem to give reasonable averages for trench pumps, it is stated:

Economical life	4 years
Depreciation	20 per cent
Interest	5 per cent
Major repairs	10 per cent
Field repairs	10 per cent
Storage, incidentals, etc.	4 per cent
Insurance	1 per cent
Taxes	1 per cent
Total expense	51 per cent

Assuming that the average period of operation for the trench pump is six months, the same as that of the piston pump, this would place the expense per working month at 8.7 per cent.

This figure, it is stated, would probably be satisfactory for computation by constructors of their own costs in the construction estimate and also in the matter of depreciation for making out income tax returns. With respect to depreciation deductions in the income tax, there is no fixed value established by the government and a construction company can secure a percentage that it is able to justify by actual facts.

Business Notes

R. E. BROOKS, president of the R. E. Brooks Co., equipment distributor, New York, has relinquished the active management of the company to accept a position in an executive capacity for Colgate University, in the affairs of which he has been interested for several years as vice-president and a director of the alumni corporation. While he will continue as president and director of the Brooks Company, the direction of that organization will pass to W. W. Bucher, who has been an officer and director of the company for the past 15 years. The company will continue its sales and service activities for the following companies: Koehring Co., C. H. & E. Manufacturing Co., Insley, Blaw-Knox, Huber, and Handy Sack Baler.

CHICAGO PNEUMATIC TOOL CO. has entered into an agreement whereby it will become exclusive distributor in the United States of the Pedwyn balancer. This device provides means for suspending, lifting and balancing of electric and pneumatic portable tools, increasing labor efficiency and decreasing overhead hazards. A stock of these balancers will be carried in all branch and service stations.

CANADIAN CONCRETE PRODUCTS, LTD., has established a sales office in Montreal at Room 312, Transportation Building. Paul Kircher has been elected vice-president of the company, with headquarters at the above address.

UNIVERSAL CRANE CO., Elyria, Ohio, has announced the appointment of the following distributors: For North Carolina, E. F. Craven, Greensboro; for Virginia, Graham B. Bright Co., Richmond; for Tennessee, Wagner Sales Co., Knoxville.

C. E. SKINNER, assistant director of engineering, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has just been elected chairman of the American Engineering Standards Committee.

NORTHWEST ENGINEERING CO., Chicago, builder of gasoline and electric convertible cranes, shovels and draglines, has appointed Borchert-Ingersoll, Inc., 2360 University Ave., St. Paul, as agents for the district about St. Paul and Minneapolis. The territory in and about Davenport, Iowa, will be handled by Girke-Robinson, Kahl Bldg., Davenport, Iowa.

W. M. PATTISON SUPPLY CO., Cleveland, equipment distributor, has completed plans for an exhibition of machinery and materials to be held on the two upper floors of its building at 777 Rockwell Ave., Cleveland. A complete line of contractors' equipment will be on display and many of the machines, such as mixers, hoists and air compressors will be shown in operation.

ANTON S. ROSING, until recently assistant manager, advertising and publications bureau, Portland Cement Association, Chicago, has been appointed publicity manager of the Armco Culvert & Flume Manufacturers' Association, Middletown, Ohio, in charge of advertising, publications and other publicity work. Mr. Rosing is a civil engineer, graduate of the University of Michigan, and a member of the Western Society of Engineers. Previous to joining the staff of the Portland Cement Association he was engaged in construction work, principally railroad construction, and for two years was assistant professor of civil engineering at Michigan Agricultural College.

HOLT MANUFACTURING CO., Peoria, Ill., has appointed the Brockway Motor Truck Co., as distributors for caterpillar tractors in central and northeastern New York.

TRUSCON STEEL CO., Youngstown, Ohio, announces that, effective in February, Oscar W. Leow assumed charge of its advertising and sales promotion work.

O. L. CHAPMAN has joined the sales organization of the Scott Valve Manufacturing Co., Detroit. He will devote his time to the application of valves to manufacturing plants and similar lines of industry.

E. M. HERR, president of the Westinghouse Electric & Manufacturing Co., has changed his headquarters from East Pittsburgh, Pa., where he has been located since 1899, to the Westinghouse Building, 150 Broadway, New York City.

HEIL CO., Milwaukee, manufacturer of dump bodies, hydro-hoists and compartment truck tanks, has appointed the Gustav Schaefer Wagon Co., 4166 Lorain Ave., Cleveland, Ohio, as distributor in the Cleveland territory. Sid Schultze, 128 E. Main St., has been appointed distributor in the Louisville (Ky.) territory.

STOW MANUFACTURING CO., Binghamton, N. Y., manufacturer of flexible shafts, grinders, drills, taximeter and speedometer cores, has appointed the Horne Co., Ltd., Osaku, Japan, as its agent in Japan, Korea, Formosa, and Manchuria.

OHIO LOCOMOTIVE CRANE CO., Bucyrus, Ohio, has recently opened a district sales office at 647 Book Bldg., Detroit, Mich., in charge of Arnold Walters, district sales manager.

Equipment and Materials

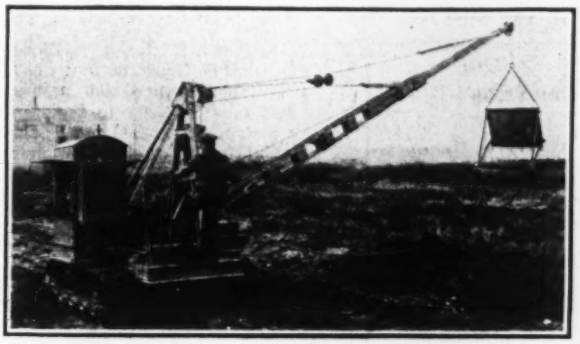
Thin Leads Improve Service of Colored Pencils

To extend the range of application and improve the service of its colored pencils, particularly in the field of the engineer, the contractor, and the draftsman, the American Lead Pencil Co., 220 Fifth Ave., New York, N. Y., has introduced a new feature in the form of thin leads instead of the large diameter leads heretofore employed. This change, the manufacturer points out, adapts the colored pencil to a great variety of engineering and commercial uses in connection with maps, plans, charts, diagrams, and general checking purposes. The colors available in the thin lead pencils are blue, red, green, and yellow. One of the innovations in these pencils, which are named "Unique," is the use of a composition for the leads which permits sharpening to a fine point and prevents the frequent breakages of leads common with the old types of colored crayons.

Among the uses suggested for the new thin colored lead pencils are in city planning layouts, mapping of streets and subsurface structures, such as sewers and water, gas and steam pipe lines, transit systems, traffic studies, progress diagrams on construction work, consulting engineers' reports, plotting curves of the results of tests of machinery or materials where it is necessary to differentiate between curves representing different conditions, marking changes in design on contract plans, flow sheets in the process industries, and organization and personnel diagrams. Engineers and contractors may obtain samples of the new thin lead pencils by addressing the company.

New Backfiller Has Boom Adjustable in Length

A new, one-man backfiller has been developed recently by the Harnischfeger Corporation, Milwaukee. It is



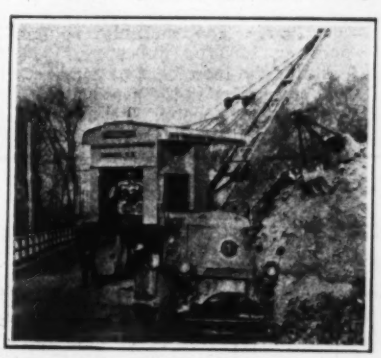
mounted on crawler treads, weighs 13,000 lb. and has a latticed boom with telescopic end adjustable in steps of 1½ ft. between 21 and 30 ft. in length.

Among the features of the machine are an all-steel construction for heavy-duty parts, steel gears and pinions with teeth double cut from the solid, all movements controlled by friction clutches, and independent drive for each of the pair of crawler treads. The boom has a half-circle swing, insuring a wide range of action from one set-up.

The scraper is fitted with renewable steel teeth and has a working speed of 130 ft. per minute and a return speed of 275 ft. per minute. Power is supplied by a 25-hp. Waukesha gasoline motor. The last reduction from the driving mechanism to the crawler is by gears, fully inclosed; no chains are used.

Lubrication Details of Mobile Crane Improved

On its locomotive crane designed for mounting on a 5-ton truck, the Universal Crane Co., Cleveland, has improved several details of lubrication. For all swing transmission oil cups



that might be neglected by a careless operator there has been substituted the Alemite forced feed system of lubrication. Another change involves the use on the motor extension shaft bearings, where the speed is reduced from 1,000 to 45 r.p.m., of sight feed oil cups instead of the solid brass cups previously used. The power equipment of the crane has been increased by the installation, on the newest models, of a 4½x6½-in. Waukesha gasoline engine developing 44 hp. at 1,000 r.p.m.

During the past year the maker of this crane reports a widening application of its use on various road-building and general construction work. It has been used, for example, with a bucket in making a 30-in. cut for paving, ditching, building berms, clearing away slips and slides, excavating for and placing culverts, driving piles, loading trucks from stock piles along the road, and stone surfacing work. These uses are in addition to the main functions of the crane in handling large tonnages of material from cars to trucks, bins or storage.

Publications from the Construction Industry

Manganese Steel Castings — AMERICAN MANGANESE STEEL CO., Chicago Heights, Ill., in an illustrated catalog, describes the long-wearing and other properties of its manganese steel castings applied particularly to machines used by contractors. This publication is supplementary to the one dealing with general uses of manganese steel products reviewed in this journal Aug. 21, p. 322. Among the applications of these castings described and illustrated are the following: Buckets, chain conveyors, bucket elevator equipment, crushers, power shovel and dredge dippers and dipper teeth; trench excavators, pumps, screens, sheaves, wheels, gears and pinions.

Internal Combustion Engines—Hercules Corporation, Evansville, Ind., describes its line of gasoline, kerosene, and oil engines in a 23-p. illustrated pamphlet. The horsepowers range from 1½ to 12 and the types include stationary and portable units.

Gravel Washing Plants—SMITH ENGINEERING WORKS, Milwaukee, has just issued a 16-p. illustrated pamphlet on Telsmith gravel washing plant, which is a companion publication to the one on quarry plant layouts, noted in this journal Feb. 12, p. 298. The booklet contains 11 line drawings of typical gravel washing plants, ranging in capacity from 25 to 150 cu.yd. per hour. With each drawing is included a list of necessary equipment and a discussion covering improvements and variations in the layout shown.

Pulleys — W. A. JONES FOUNDRY & MACHINE CO., Chicago, has just published two new catalogs. The first deals with power transmission machinery, including shaft hangers, pillow blocks, couplings, collars, etc., the second is devoted to sprocket wheels and chain belting.

Engineering News-Record Statistics

Of the Construction Industry in the United States

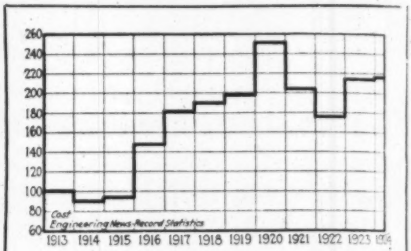
Engineering News-Record Construction Cost Index Number (1913 = 100)

March, 1925	**210.20**
February, 1925	209.70
March, 1924	224.60
Peak, June, 1920	273.80
1913	100.00

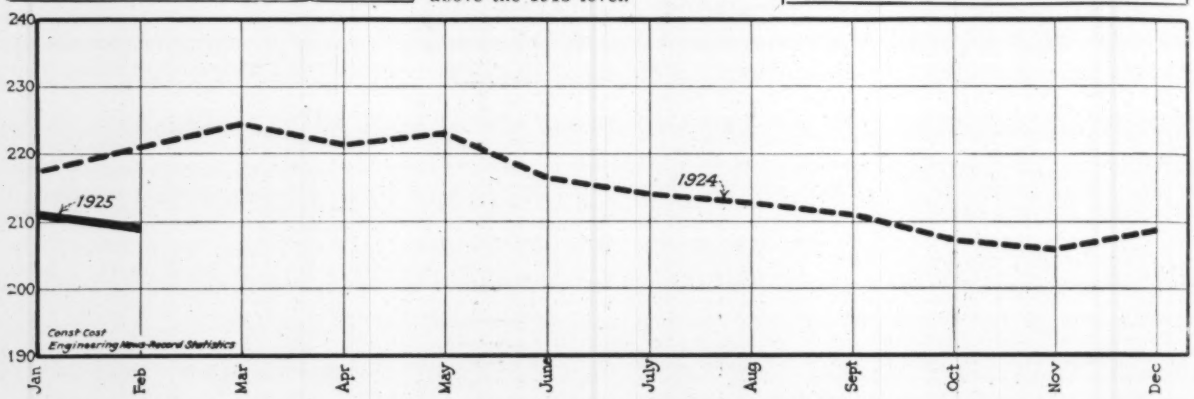
1924		1924	
January	217.90	July	214.40
February	220.30	August	213.15
March	224.60	September	211.25
April	221.60	October	207.55
May	222.33	November	205.70
June	216.85	December	208.58

1925	
January	210.40
February	209.70
March	210.20

ENGINEERING NEWS-RECORD'S Construction Cost Index Numberadvanced 0.5 points since last month owing to slightly higher cost of structural materials and a tightening of the common labor situation as spring approaches. The average rate for common laborers is now 54¼c. per hr. for the entire country, against 54c. one month ago and 55c. in March, 1924. Thus general construction cost is 6 per cent lower than one year ago and 23 per cent under the peak; it is 110 per cent above the 1913 level.



ENGINEERING NEWS-RECORD'S CONSTRUCTION COST INDEX NUMBER, YEARLY—1913 = 100



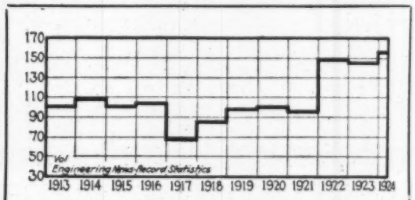
Engineering News-Record Construction Volume Index Number (1913 = 100)

February, 1925	**145**
January, 1925	141
February, 1924	144
Peak, May, 1922	221
1913	100

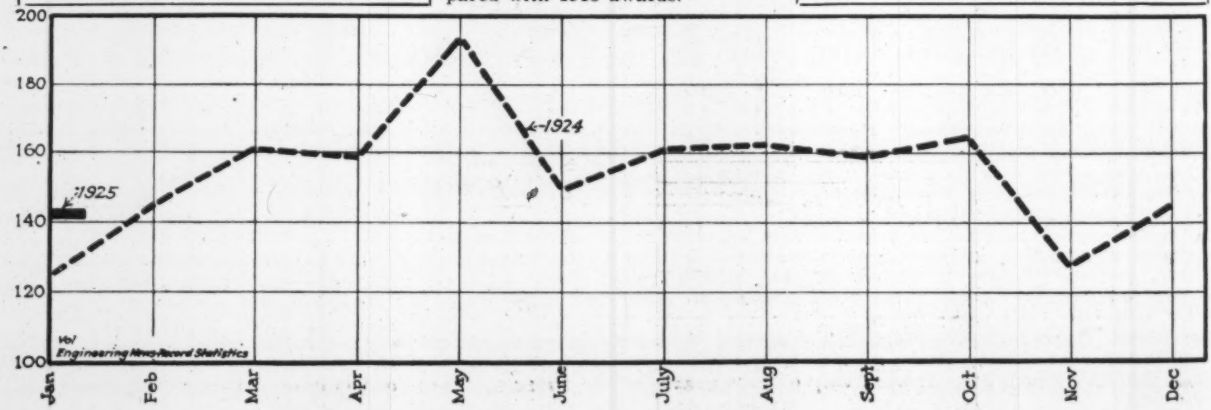
1924		1924	
January	125	July	161
February	144	August	162
March	161	September	159
April	159	October	164
May	194	November	128
June	149	December	145

1925	
January	141
February	145

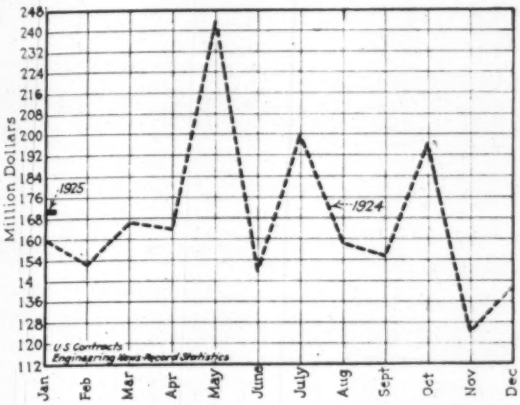
ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 145 for the month of February, and 154 for the whole of 1924, as against 100 for 1913. This means that the actual volume of construction in 1924 (not the mere money-value of the contracts let that year) is 54 per cent above the volume of construction for 1913. The monthly volume number, 145 for February, 1925, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.



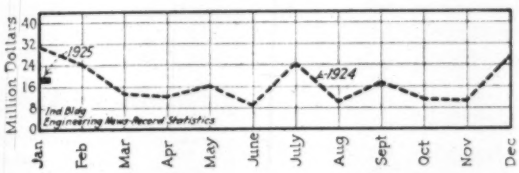
ENGINEERING NEWS-RECORD'S CONSTRUCTION VOLUME INDEX NUMBER, YEARLY—1913 = 100



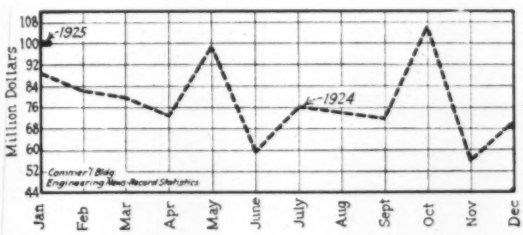
Engineering News-Record Statistics



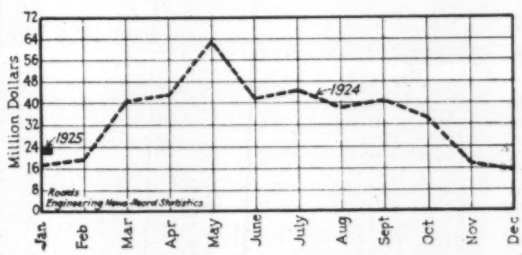
Contracts Awarded in the United States



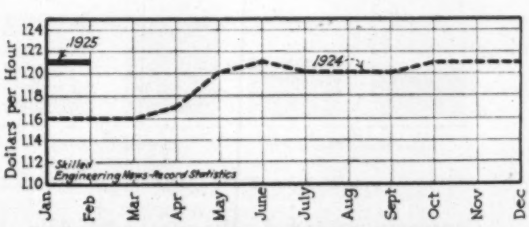
Industrial Building Awards, $40,000 Minimum



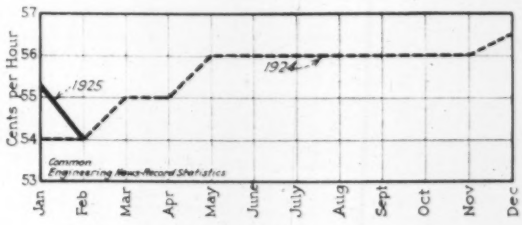
Commercial Building Awards, $150,000 Minimum



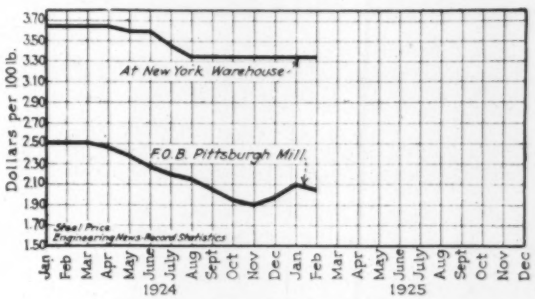
Street and Road Lettings, $25,000 Minimum



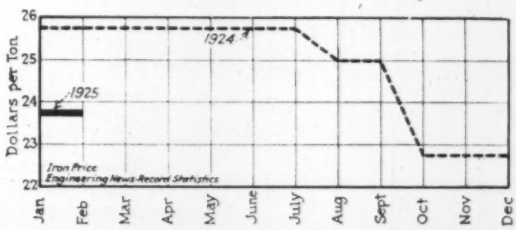
Average Wage of Skilled Building Trades



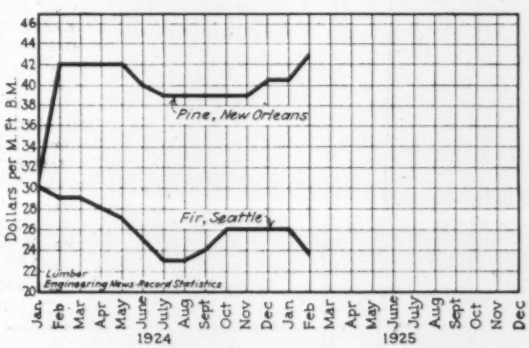
Average Common Labor Rate—U. S.



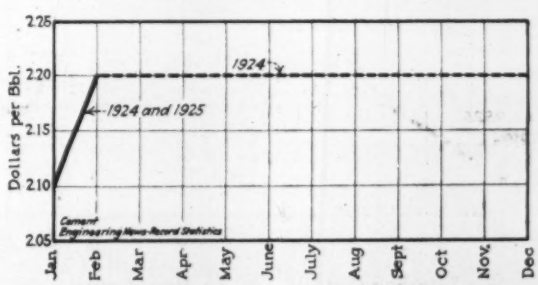
Price of Steel Structurals



Price of Basic Pig Iron at Pittsburgh

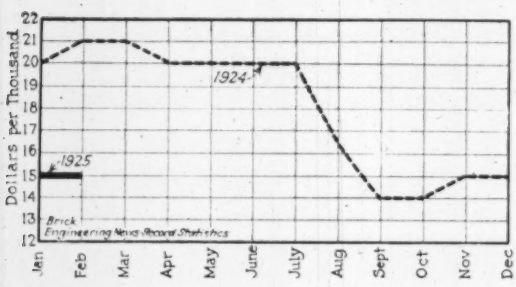


Price of Timbers, Wholesale, Base Sizes

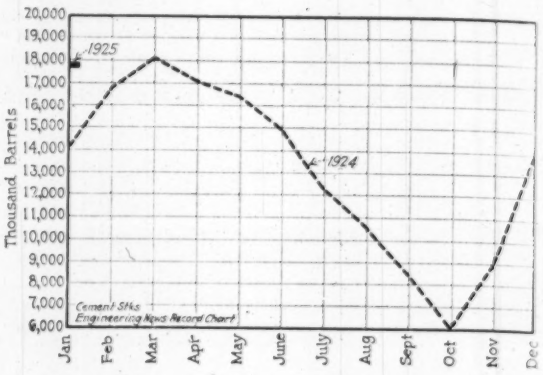


Price of Portland Cement, Net, F.O.B. Chicago

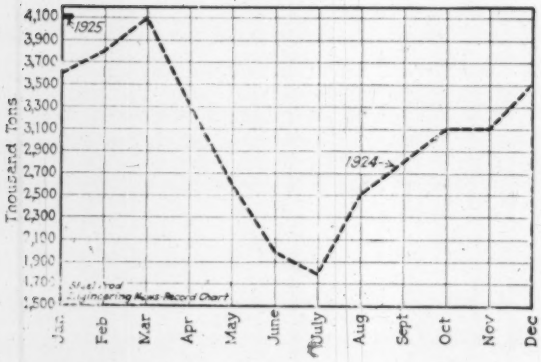
Engineering News-Record Statistics



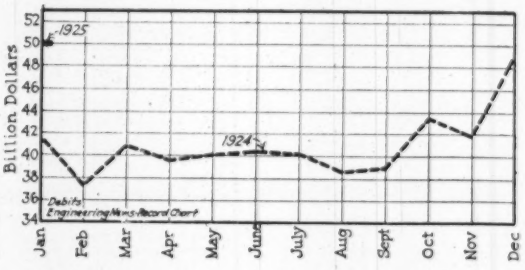
Price of Brick at New York Dock



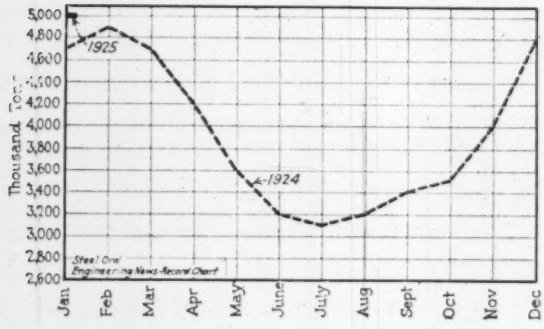
Cement Mill Stocks—Geol. Survey



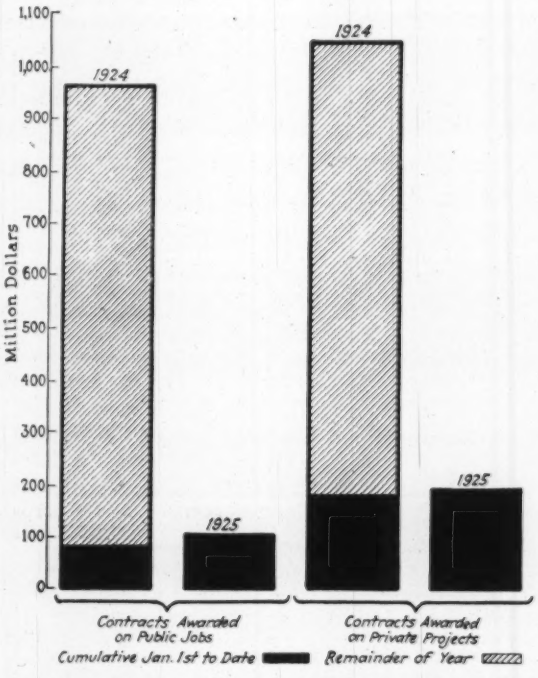
Steel Ingot Output—Am. I. & S. Inst.



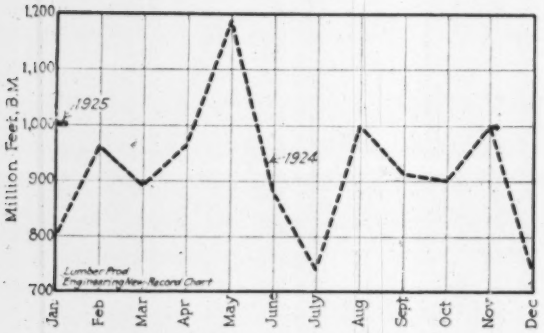
Bank Debits, U. S.—Federal Reserve



Unfilled Tonnage—U. S. Steel Corp.



Contracts Awarded—Private and Public



Lumber Output—N L. Mfr. Assoc.

Construction Awards for First Eight Weeks of 1925 Ahead of Corresponding Period Last Year

AGAIN of 3 per cent in average weekly lettings on large engineering construction projects, was realized during February as compared with the month preceding.

Compared with February, 1924, the past month showed a decline of 5½ per cent in money value of contracts let.

Thus far, this year has followed very much the same characteristics as those shown by 1924, with the exception that the money value of 1925 awards is considerable heavier.

The totals in the accompanying table include no lettings under $15,000 for waterworks and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Based upon the given minimum in each case, lettings for the first eight weeks of this year amounted to $313,600,000 as compared with $309,915,000 for the corresponding period in 1924.

In view of the fact that February was a short month, notable gains were recorded in water-works, sewers, excavations, drainage and irrigation projects and Federal Government work, compared with the month preceding.

Construction activity is greater in New England and the Middle West, compared with this time last year. The other sections of the country do not compare so favorably. If present programs of projected work are carried out, this spring will at least equal the 1923 volume of construction for the corresponding period.

The January total of contracts let as published in the Feb. 5 issue of *Engineering News-Record*, p. 255, contained a single project valued at $52,200,000. This work involves a 460,000 hp. hydro-electric power plant to be erected at Conowingo, Md., for the Susquehanna Power Co., and also provides for a 3,680 ft. dam, 103 ft. high at spillway section, across the Susquehanna River.

The amount of the contract has been temporarily deducted from the total owing to the fact that the Public Service Commission will not approve the project until protection of the Baltimore water supply, fish life, State roads and bridges and regulation of rates and practices of the Power Company have been adequately provided for. The project will probably be abandoned.

Value of Contracts Let in the United States and Canada, February, 1925

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States	Canada	Grand Total
Water works	$15,000	$3,351,000	$106,000	$277,000	$897,000	$874,000	$5,520,000	$28,000	$5,548,000
Sewers	25,000	735,000	116,000	904,000	247,000	1,939,000	3,964,000	76,000	4,040,000
Bridges	156,000	2,625,000	489,000	736,000	364,000	77,000	4,367,000	.....	4,367,000
Excavation, dredging, etc.	.....	.....	1,025,000	15,000	338,000	276,000	1,654,000	25,000	1,679,000
Streets and Roads	414,000	2,061,000	5,447,000	6,406,000	3,209,000	2,167,000	19,704,000	400,000	20,104,000
Industrial Building	610,000	1,340,000	2,130,000	1,222,000	505,000	1,540,000	7,347,000	.....	7,347,000
Commercial Building	10,436,000	30,416,000	3,413,000	8,402,000	14,458,000	15,133,000	82,258,000	800,000	83,058,000
Federal Government	43,000	16,000	1,946,000	.....	167,000	1,194,000	3,366,000	.....	3,365,000
Unclassified	25,000	10,890,000	1,101,000	285,000	801,000	338,000	13,440,000	329,000	13,769,000
Feb. 1925	$11,724,000	$51,432,000	$15,693,000	$18,247,000	$20,986,000	$23,538,000	$141,620,000	$1,658,000	$143,278,000
Feb. 1924	4,886,000	61,400,000	19,340,000	17,162,000	21,290,000	25,884,000	149,962,000	15,084,000	165,046,000
Jan. 1925	12,923,000	52,364,000	15,775,000	27,346,000	37,573,000	25,999,000	171,980,000	4,861,000	176,841,000
Two months 1925	24,647,000	103,796,000	31,468,000	45,593,000	58,559,000	49,537,000	313,600,000	6,519,000	320,119,000

Labor Rates and Conditions Throughout The Country

THE construction industry began 1924 with a two-fold handicap consisting of a shortage of brick and other basic building materials, combined with scarcity of skilled mechanics, such as, bricklayers, plasterers, etc.

This year, the situation is quite the reverse. Materials are sufficiently plentiful to justify the present policy of restricted production. Brick is especially plentiful.

At least nineteen out of the twenty-one cities reporting regularly to *Engineering News-Record* show no existing labor scarcities, skilled or otherwise.

Two cities of the twenty-one report wage demands pending or negotiations already under way. There are strikes in force in only one locality and no serious labor troubles threaten to disturb the coming spring building season. Local conditions follow:

Atlanta—A surplus of building trades mechanics exists in Atlanta at the present time, owing to slowness in the construction industry. A great many workers of the migratory type have also helped to flood the labor market.

Baltimore—Slight unemployment reported in the building trades due to seasonal curtailment of construction activities.

Birmingham—Building is unusually active in industrial as well as in commercial and residential work. Despite this fact there is an oversupply of mechanics in the Birmingham district.

Boston—Construction is active with very little unemployment in the building trades. Common laborers very plentiful.

Chicago—An agreement has been signed between the Structural Iron Workers Union and the Iron League of Chicago, under which a wage increase of 12½c. per hr. has been guaranteed, effective June 1. The new rate will be $1.37½ per hr., against $1.25 at the present time. Marble workers received a similar increase.

Cincinnati—Construction is slow, with consequent unemployment of carpenters and other mechanics.

Cleveland—Building trades unions making no concerted effort to establish 5-day week.

Denver—An extensive spring building program will take care of all unemployed on hand at the present time.

Detroit—Conditions are very satisfactory from the standpoint of the employers, with no shortage of men in any trade.

Kansas City, Mo.—Small surplus of bricklayers, carpenters and painters.

Minneapolis—Very small amount of unemployment reported in the skilled building trades.

Montreal — Unemployment situation beginning to show definite signs of improvement.

New Orleans—Slight excess of building trades craftsmen reported, despite active building program. New Orleans is one of the Southern cities affected by migratory workers.

New York—Building is gaining in Manhattan and the Bronx and gradually decreasing in the other boroughs With the exception of wire lathers, iron workers, derrickmen and riggers, no other crafts are engaged in wage disputes or other labor troubles.

Philadelphia—Surplus reported in all building crafts, particularly carpenters, painters and electricians.

Pittsburgh — Carpenters are asking for a wage increase and common laborers demand 90c. per hr., against the present rate of 70c.

St. Louis — More winter building under way than ever before. Steady employment of men in various trades is reported by contractors and union labor leaders.

San Francisco—In the Bay district construction is very active, with consequent employment of building labor.

Seattle—The greatest period of activity in recent years, is now being experienced in the Seattle district.

Business Briefs

Call money rated at 4½ per cent, March 2.

Time loans: short terms, 4@4¼ per cent; longer periods, 4¼@4½ per cent.

Commercial paper: best names, 3¾ per cent; other names, 4 per cent.

Foreign exchange (Demand)

	Normal	This Week	Last Week	Year Ago
Sterling	$4.8665	$4.75⅛	$4.75⅛	$4.29⅛
France	0.193	0.0505⅛	0.0518⅛	0.0407⅛
Lira	0.193	0.0400⅞	0.0409⅛	0.0429
Mark	0.238	0.238	0.238	.....

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1 12½	$0.70	$0.70	$0.50	....	$0.75	$0.25@.30
Baltimore	1.75	.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	+ .35@.87½	.75@1.25	50@.75	....	.75@1.25	.25@.40
Boston	1.25	1.00@1.10	1.25@1.35	.82½	1.05	1.25	.50@.75
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	.55
Chicago	1.50	1.15@1.25	1.10@1.25	1.00	1.25	1.25	.75@.82½
Cleveland	1.50	1.25	1.30	.87½	1.00	+1.50	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	81¼@.87½	1.00	1.15¾	.35@.55
Detroit	1.50	.90@1.00	.85@1.00	.90	.85@1.00	1.12½	.60@.75
Kansas City	1.50	+1.25	+1.12½	.90	1.00	1.00@1.12½	.40@.75
Los Angeles	1.00@1.25	.87½@.100	.75	.87½@1.12	.87½	.87½@1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	....	.87½	.50@.55
Montreal	.90	.45@.65	.62½	.30@.35	.50	.65	.25@.30
New Orleans	1.25	.90	1.00	.65	.80	1.12½	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	+1.50	.62½@.7
Philadelphia	1.50	1.12½	1.02½	1.12½	1.00	1.12½	.40@.45
Pittsburgh	1.55	1.37½	1.25@1.37½	1.00	....	1.37½	.70
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@.77½
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	+1.37½	1.00	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

Monthly Prices of Construction Materials

Ups and Downs of the Market

CONSTRUCTION cost is a trifle higher this month than last, owing to increasing firmness in structural materials and the slightly advanced wage rate for common labor. The trend is upward in such materials as iron, steel, c.-i. pipe, paving stone, lime, tile, wire nails, roofing materials, rope, water and sewage treatment chemicals. Declines are noted in scrap, light rails, sewer pipe, wood blocks, cement, rivets, cut nails, linseed oil and explosives.

Pig Iron—Prices are holding firm despite a drop of $1 per ton in scrap. Quotations are $2 per ton higher than a month ago in New York, Cincinnati and Birmingham; up $2.50 per ton in Chicago. The general line up is slightly under the level of a year ago.

Railway Supplies—Most of the activity in the current market consists of pressure for mill shipments on orders already placed for rails and track supplies. Prices are not fluctuating.

Pipe—Cast-iron pipe is decidedly firmer in Birmingham and Chicago; the movement has not yet extended to the other important markets. Sewer pipe is seasonally slow with declines reported in several sities. Steel pipe is featureless.

Road and Paving Materials—Average weekly road lettings were heavier in February than during the month preceding. The price situation shows conflicting trends. In the West, asphalt is rising and declines are reported in wood blocks. Along the Atlantic seaboard, asphalt is lower and quotations are higher on paving stone.

Sand, Gravel and Crushed Stone—Prices of aggregates remained unchanged throughout the month, in twenty-one cities reporting regularly to *Engineering News-Record*.

Lime and Cement—Firmness is developing in the Southern and Western lime markets, while New England reports declines. Cement prices are a trifle softer along the Atlantic coast. A mill reduction of 5c. per bbl. is reported in the Middle West. Output and demand are seasonally slower; mill reserves are heavier than at the end of 1924.

Brick and Hollow Tile—Taking the situation in twenty-one of the most important centers, the only two changes in brick prices were, a rise in Dallas and a decline in Minneapolis; tile is higher in Philadelphia, New Orleans and Birmingham and down in Boston, Kansas City and Atlanta.

Structural Steel—Pittsburgh mill prices range from $2 to $2.20 per 100 lb. on steel shapes and plates; bars are firmest of the hot rolled products, at $2.20 per 100 lb. This represents an advance of about 10c. per 100 lb. over last month. Demand is fairly active in steel tank and ship plates. There is also considerable buying of structural material.

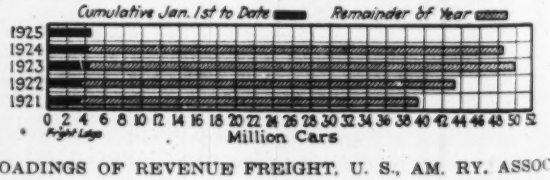
Lumber—Mills are considerably oversold on long-leaf yellow pine timbers and railroad material. Lath and flooring are also in good demand. The lumber movement for the entire country during the past month, has shown no perceptible decrease in volume, from week to week. The price situation is uneven. Pine is tending higher in New York and Boston; firmness in fir is reported in San Francisco. Detroit reports declines in pine; Denver and Philadelphia, in fir and hemlock; and Philadelphia, in spruce timbers.

Iron and Steel Scrap—Prices have dropped aonther dollar per ton, making the second decrease of this kind since January. This is in direct contrast with the firmness prevailing in iron and steel.

Miscellaneous Materials — Firmer tendencies prevail in such materials as wire nails, roofing materials, rope, water and sewage treatment chemicals. The market is a trifle softer in rivets, cut nails, linseed oil and explosives.

Car Loadings Continue Heavy

That movements of revenue freight, by the railroads of the country, are well above the 1923 level for this time of the year, but are still slightly under the mark reached in 1924, is shown by reports of the American Railway Association, dated Feb. 26. The accompanying illustration shows the situation up to and including the week of Jan. 31, 1925.



LOADINGS OF REVENUE FREIGHT, U. S., AM. RY. ASSOC.

E. N.-R. Prices of Construction Materials

Prices advance since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Mar. 5	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	**$26.05**	$25.05
Northern Basic	23.77	24.00
Southern Ohio No. 2 (silicon 1.75@2.25)	23.77	24.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	**32.25**	28.00
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	**22.00**	23@24
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.76	24.25
Virginia No. 2 (silicon 2.25@2.75)	30.17	28.17
Basic	24.76	24.00
Gray Forge	23.75	24.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	22.00	24.50
No. 2 Foundry Southern (silicon 2.25@2.75)	**28.01**	27.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	23.77	25.77
Basic	23.77	25.77
Bessemer	23.77	26.77

SCRAP—The prices following are f.o.b., per gross ton paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	*$14.00*	$16.50@**17***	$14@15
Stove plate	*11.00*	*15@15.50**	15@16
No. 1 machinery cast	*14.00*	19@19.50*	17@**17.50**
Machine shop turnings	*10.00*	12@12.50	8@9
Cast borings	*10.00*	**15**@15.25	15@16
Railroad malleable	*13.00*	20@20.50	18@19
Re-rolling rails	*14.00*	*19.50@20*	**20@21**
Re-laying rails	*20.00*	25@**31**	26@27
Heavy melting steel	*13.00*	18@18.50	

*Per net ton.

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				St.
	Mar. 5	One Year Ago	Birmingham	Chicago	Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$46@49
Standard openhearth rails	43.00	43.00	43.00	43.00	48@52
Light rails, 8 to 10 lb.	*33@36*	40@43	36@38	1.90@2.00*	
Light rails, 12 to 14 lb.	*33@36*	40@43	36@38	1.90@2.00*	2.05@2.15*
Light rails, 25 to 45 lb.	36.00	40@43	36@38	1.90@2.00*	1.95@2.10*
Re-rolled rails	27@32	37@40			

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.60	$2.00
Chicago, (creosoted) (zinc treated)	1.70	2.10
San Francisco, Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak, plain	1.20	1.40
St. Louis (creosoted) (zinc treated)	1.60	1.90
St. Louis, Red Oak, plain	1.10	1.30
St. Louis, Sap pine-cypress	.95	1.15
Birmingham, White Oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh				San	
	Mar. 5	One Year Ago	Chicago	St. Louis	Francisco	Birmingham
Standard spikes, ¾-in. and larger	$2.90	$3.05@3.15	$3.55	$3.55	$4.35	$2.90
Track bolts	3.90@4.25	4.00@4.25	4.45	4.55	5.85	**3.90**
Standard section angle bars	2.75	2.75	3.30	3.40	4.00	**3.85**

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	59½%	62%	49%
3½ to 6 in. lap welded	48%	56½%	59%	48%

	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	48%	50½%	36%
3½ to 6 in. lap welded	35%	45%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Pittsburgh	New York	
			Mar. 5	One Year Ago
4 in.	**$52.20@54.20**	$53.20@54.20	$59.60@60.60	$67.10@68.60
6 in. and over	**43.20@50.20**	49.20@50.20	54.60@55.60	61.60@63.60

	Chicago	St. Louis	San Francisco
4 in.	**$54.20**	$52.00	$57.00
6 in. and over	**50.20**	48.00	53.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

	New York					
Size, In.	Mar. 5	One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$45.00	$40.00	$45.00		$73.00
4	50.00	55.00	40.00	56.00	$76.50	110.00
5	70.00	80.00		80.00	97.75	118.00
6	92.00	105.00	70.00	100.00	127.50	150.00
8	160.00	170.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3		$0.09	$0.10			$0.12	
4		.09	.10	$0.10		.15	$0.15
5		.135	.135			.18	.18
6	$0.21	.135	.135	.14		.21	.21
8	.35	.21	.21	.225		.30	.325
10	.52	.315	.315	.315		.42	.476
12	.67	.405	.45	.405†		.56	.612
15	1.14†	.54	.54	.675†		.90	1.02
18	1.65†	.75	.75	.945†		1.32	1.53
20	1.98†	.90	.90	1.26†			1.564
22	2.65†	1.20	**1.20**			2.16	2.04
24	2.97†	1.35	1.35	1.62†		3.00	3.34
27	4.65†	2.665	**2.665**	2.45†		3.60	4.06
30	5.16†	2.952	**2.952**	3.00†			4.99
33	6.98†	3.96	**3.96**	3.55†			5.42
36	8.00†	4.51	*4.51*	3.95†			

	3	5	8	12	24	36
Boston	$0.13	$0.20	$0.35	$0.70	$2.20	$3.90†
Minneapolis			*.25*	*.45*	*1.50*	*2.76†*
Denver	.135*	.18*	.27	.47	1.70	
Seattle	.14		.35	.72†	2.60†	
Los Angeles	.1625	.195	.275	.495	1.65	
New Orleans	.115*	.177*	.295	.5015	1.9175	
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	**.11***	.15*	.25	.425	1.625	
Montreal	.68‡	.45†	.70	1.35	4.50†	
Detroit	0.93	.1395	.217	.4185	2.115†	5.535†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	**.21***	**.31***	**.52**		**3.07†**	**5.00†**
Philadelphia	.12	.18	.28	.54	1.80	4.61

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Mar. 5	One Year Ago
New York, 45% asphalt	(at terminal)	$0.07	$0.053
New York, 65% asphalt	(at terminal)	.0725	.051
New York, binder	(at terminal)	.075	.06
New York, flux	(at terminal)	.075	.04
New York, liquid asphalt	(at terminal)	.075	.048
St. Louis, 40@50% asphalt		.0592	.05½@.05¾
St. Louis, 50@60% asphalt		.0597	.05
Birmingham, 55% asphalt		.0475	
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$23.00*	$18.00
Boston (*Mexican*)	21.00	16.00
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	22.25	20.50
Denver (*California*)	24.00	
Minneapolis, *f.o.b. Twin Cities (Stanolind)*	25.10	19.10
St. Louis (*Mexican*)	27.00	23.00
Baltimore (*Mexican*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	*29.75*	*25.75*
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)		11.65
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	*20.00*	*16.00*
Kansas City (*Texas*)	27.30	22.30
Los Angeles (*"D" grade, California*)	19.10	12.00†
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	23.00	17.00

*In drums. †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$135.00@142.00 per M.
Chicago	About 4x8x4 dressed	per sq.yd.
	About 4x8x4 common	per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	130.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4	1.65 per sq.yd.
Kansas City	Granite	4.00 per sq.yd.
Philadelphia	Granite	3.00@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.20 per lin.ft.
Chicago	18 in. wide	per lin.ft.

CURBING—*New York:* Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 85c.; 5x20 in., Queens, 90c. *St. Louis:* Class "A" straight, delivered, 5x18 in., $1.00 per lin.ft.; roundings, $1.50.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York (*delivered*)	3	16	$2.51
New York (*delivered*)	3½	16	2.82
Boston	3½	18	2.55
Chicago	4	16	
Chicago	3½	16	
St. Louis	3½	16	2.40
St. Louis	4	16	2.70
Seattle	4	16	Off market
Minneapolis	3½	16	*2.49*
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	
Cincinnati	3½	16	2.38
Kansas City	4	16	3.95
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Mar. 5	One Year Ago	Mar. 5	One Year Ago	Mar. 5	One Year Ago
New York (*alongside dock*)	$1.75	$2.00	$1.75	$2.00	$1.25	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	3.00	2.00	3.00	2.00	3.00	2.00
St. Louis	1.45	1.40†	1.45	1.45†	1.18	1.20
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.00	2.00	2.00
Minneapolis	1.65*	1.85*	1.65*	1.85*	1.25	1.25-1.50
Cincinnati	1.40†	1.35†	1.40†	1.35†	1.35†	1.30
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.40†	1.50†	1.40†	1.00†	1.10†
New Orleans	2.63	2.85	2.63	2.85	1.75	1.25
Los Angeles	*1.35*†	2.50	*1.40*†	2.50	0.90*†	1.75
Atlanta	1.90†	2.00†	1.90†	2.00†	1.40†	1.40†
Detroit	2.02	1.62	2.02	1.62	1.62	2.02½
Baltimore	1.40	1.40	1.60	1.60	0.70†	0.70†
Montreal	1.25†	1.25†	1.25†	1.50†	1.25†	1.25†
Birmingham	2.00		2.00		1.45†	1.30†
Philadelphia	2.10	2.15	2.10	2.15	1.50	1.65
Kansas City	4.00		4.00		0.66*	0.66*†

New York—Grits, *$1.75* per cu. yd.; ready mixed, **$2.00**.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit. † Per ton.

CRUSHED STONE—Price for cargo or carload lots, f.o.b. city, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Mar. 5	One Year Ago	Mar. 5	One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	3.00	2.00	3.00	2.00
St. Louis	1.75*	1.75*	1.75*	1.75*
Dallas	2.40	2.83	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.55*	1.60*	1.55*
Minneapolis	1.75	1.85	1.75	2.00
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	3.50	2.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	1.90*	1.65*	1.90*	1.65*
Los Angeles	*1.45*†	2.75	*1.55*†	3.00
Detroit	1.70	1.75	1.70	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal	2.25*		2.25*	
Philadelphia	2.10	2.15	2.10	2.15
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00		2.00	

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.25	$1.35	$2.00	$1.25
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.			2.50	
Birmingham, Ala.	*.90*	*1.15*	2.05	.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.30	1.30	1.30	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.50	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton— Finishing	Common	Lump, per Barrel— Finishing	Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.50@2.75*
Chicago	20.00			1.25†
St. Louis	24.00	19.00		1.23†
Boston	20.00	15.00	*3.80**	3.10*
Dallas	20.00			1.85†
Cincinnati	16.80	14.30		13.40‡
San Francisco	22.00			1.60†
Minneapolis	23.00	21.00 (white)	1.60†	1.35†
Denver	24.00			2.70†
Detroit	16.00			17.00‡
Seattle, *paper sacks*	24.00		2.80†	
Los Angeles	18.00			2.70†
Baltimore	24.25	17.85	2.55†	
Montreal		21.00		10.50‡
Atlanta	22.50	14.00	2.10†	1.45†
New Orleans	24.00	17.00	2.00†	2.00†
Philadelphia	23.00	16.00		
Kansas City	29.60	25.60		
Birmingham	22.50	15.00	2.10†	1.75†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Mar. 5	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.80
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.50	2.70
St. Louis (Carney)	2.35	2.45
Birmingham (Magnolia) pozzolan cement	2.40	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Mar. 5	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.55*	2.60	2.63
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.19
Cleveland	2.39	2.39	2.39
Detroit	2.35	2.35	2.40
Indianapolis	2.41	2.41	2.31
Milwaukee	2.35	2.35	2.35
Duluth	2.19	2.19	2.19
Peoria	2.37	2.37	2.27
Cedar Rapids	2.44	2.44	2.40
Davenport	2.39	2.39	2.29
St. Louis	2.30	2.30	2.20
San Francisco	2.61	2.61	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.42	2.42	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.90
Dallas	2.05	2.05	2.05
Atlanta	*2.30*	2.35	2.35
Cincinnati	2.47	2.47	2.37
Los Angeles	2.80	2.80	3.00
Baltimore	2.90	2.90	2.50
Birmingham	2.40	2.40	2.80
Kansas City	2.07	2.07	2.10
Montreal	1.80	1.80	2.72
Philadelphia	2.41	2.41	2.41
St. Paul	2.42	2.42	2.42
Toledo	2.40	2.40	2.40

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.10
Iola, Kan.	1.95	Alpena, Mich.	*1.95*
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$0.95	$1.39	$1.04	$1.13	*$1.20*
049	28	1.23	1.20	1.76	1.32	1.38	*1.42*
068	35	1.51	1.50	2.16	1.62	1.67	1.87
093	45	1.94	1.93	2.77	2.08	2.00	2.40
126	57	2.39	2.38	3.45	2.57	2.55	2.97
153	68	2.86	2.85	4.11	3.07	3.15	.....
180	78	3.28	3.28	5.70	3.52	3.47	.....
245	103	4.33	4.42	6.21	4.65	4.58	.....
287	119	5.00	4.95	7.19	5.38	5.26	6.23
336	138	5.80	5.75	8.35	6.23	6.11	.....
395	160	6.72	6.50	9.65	7.22	7.12	.....
PAVING							
036P	17	$0.74	$0.74	$1.06	$0.80	$0.76	.....
053P	24	1.04	1.05	1.50	1.12	1.07	.....
072P	31	1.32	1.32	1.90	1.42	1.39	.....
097P	40	1.70	1.70	2.45	1.83	1.90	.....
049R	24	1.04	1.04	.....	1.12	1.07	.....
067R	31	1.32	1.30	.....	1.42	1.39	.....
089R	40	1.70	1.70	.....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	St. Louis	San Francisco	Dallas
2.2	*$19.00*	$22.00	*$19.00*	$24.00	$23.50
2.5	*20.50*	23.00	21.00	26.00	25.00
3.0	*23.50*	26.00	24.50	30.00	28.50
3.4	*25.00*	28.00	26.50	.....	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Warehouse, Uncut: Pittsburgh Mill	Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.20	$2.25	$3.24	$3.00	$3.15	$3.38	$3.35
⅝	2.30	2.35	3.34	3.10	3.25	3.43	3.45
¾	2.40	2.45	3.44	3.20	*3.35*	3.48	3.55
⅞	2.60	2.65	3.64	3.40	*3.55*	3.63	3.75
1	2.20	3.25	4.24	4.00	*4.15*	3.78	4.35

For size and cutting extras, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	*$2.60**	$3.08	⅝	*$3.00**	$3.30
¾ in.	*2.70**	3.13	1	*3.70**	3.48
1¼	*2.80**	3.18			

* Warehouse shipments.

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Mar. 5	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$18.00	$18.00	$23.65@25.85	$45.00	$51.00
New York (at dock)	15.00	15.00	20@22		
Chicago	12.00	12.00	11.00	50.00	50.00
St. Louis, salmon (del.)	16.00	16.00	16@18		40.00
Denver, salmon	12.00	12.00	12.00		
Dallas	12.10	11.60	11.60	35.00	
San Francisco	15.50	15.50	15.50		
Los Angeles	13.00	13.00	14.50	(not used)	
Boston (del.)	19.00	19.00	22.00	45.00	*51.00*
Minneapolis (del.)	*13.50*	15.00	16@18		
Kansas City	14.50	14.50	16.50	(no market)	
Seattle	14.50	14.50	15.00		42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	17.50	17.50	17.50	100.00†	68.00
Detroit (del.)	17.50	17.50	17.50	38.50	41.50
Baltimore	18.00	18.00	21.00	40.00	45.00
Atlanta	10.50	10.50	12.00	40.00	
New Orleans	15.00	15.00	18.75		
Birmingham	12.50	12.50	12.50@14	40.00	45.00
Philadelphia	19.00	19.00	21.00	38.00	46.00
Pittsburgh (del.)	16.00	16.00	16.00		
Cleveland	14@16	14@16	16.00		

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Mar. 5 on Trucks*†	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1162	$0.1179	$0.06	$0.1325	$0.078	$0.108	.....
6x12x12	.1743	.1769	.0825	.....	.104	.156	.....
8x12x12	.2179	.2211	.1125	.25	.146	.244	.....
10x12x12	.....	.....	.14	.....	.175	.....	$0.2388
12x12x12	.....	.....	.18	.....	.200	.....	.2956

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	*$0.10*	$0.20	
Minneapolis (f.o.b. cars)	.063	.11	$0.195
Minneapolis (delivered)	.07	.12	.21
Cincinnati	.07485	.13745	.....
Kansas City	*.085*	*.135*	.....
Denver	.085	.155	.188
Seattle (delivered)	.11	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.....	.30
Detroit (delivered)	.0815	.1529	.....
Montreal	.12	.225	.30
Baltimore	.125	.27	.....
Atlanta	*.0808*	*.1516*	.....
Dallas	.0941	.1824	.265
Birmingham	.11	.1824	.22
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.064	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00@2.20	$2.05	$3.34	$4.15	$3.25	$3.10	$3.15
Channels, 3 to 15 in.	2.00@2.20	2.10	3.34	4.15	3.25	3.10	3.15
Angles, 3 to 16 in., ¼ in. thick	2.00@2.20	2.10	3.34	4.15	3.25	3.10	3.15
Tees, 3 in. and larger	2.00@2.20	2.10	3.34	4.15	3.35	3.10	3.15
Plates, ¼ in. thick and heavier	2.00@2.20	2.00	3.34	4.15	3.25	3.10	3.15

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York—Mar. 5	New York—One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	*$2.50@*	$2.60	$4.25	$4.40	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	*$2.85@*	$2.90	$4.35	$4.50	$3.75	$3.75	$5.20	$5.00
⅝ and ¾	*3.00@*	3.05	4.50	4.66	3.80	4.20@4.45	5.35	5.15
⅞ and 1	*3.25@*	3.30	4.75	4.90	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.85@2.95	*$2.85*	$3.25	$4.00	*$4.75*	$3.18	4.95
Cut	2.90	*2.90*	.....	5.25	5.00	3.28	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	Black	Seattle Black
½	$8.00	$6.00	$7.75
⅝	7.30	5.30	5.40
¾	7.15	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.86 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $7.56 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.35 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$87.75
Tar pitch (in 400-lb. bbl.), per 100 lb.	2.03
Asphalt roofing (in barrels), per ton, f.o.b. plant*	41.51
Asphalt felt (light), per ton, f.o.b. plant*	95.00
Asphalt felt (heavy), per ton, f.o.b. plant*	95.00

* Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent, "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.70@2.80	$3.90	$3.80	$4.20	$3.89
No. 12	2.80@2.90	3.95	3.85	4.25	3.94
No. 16	2.90@3.00	4.00	3.95	4.30	3.99
No. 16	3.10@3.20	4.10	4.15	4.40	4.09
Black					
*Nos. 18 and 20	3.35@3.55	4.45	4.30	5.05	4.55
*Nos. 22 and 24	3.40@3.60	4.50	4.35	5.10	4.60
*No. 26	3.45@3.65	4.55	4.40	5.15	4.65
*No. 28	3.50@3.70	4.65	4.50	5.25	4.75
Galvanized					
No. 10 and 11	3.75@3.85	4.65	4.50	5.75	4.75
No. 12 to 14	3.85@3.95	4.75	4.60	5.35	4.85
No. 16	4.00@4.10				5.00
Nos. 17 to 21	4.15@4.25	5.05	4.90	5.65	5.15
Nos. 22 to 24	4.30@4.40	5.20	5.05	5.80	5.30
*Nos. 25 and 26	4.45@4.55	5.35	5.20	5.95	5.45
*No. 28	4.75@4.85	5.65	5.50	6.25	5.75

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages: for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Mar. 5	New York: One Year Ago	Chicago: Mar. 5	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$1.21*	$0.97	$1.25	$0.94

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound, f.o.b. New York:

	Dry		In Oil	
	Mar. 5	1 Yr. Ago	Mar. 5	1 Yr. Ago
Red	$16.25	$15.00	$17.75	$16.50
White	16.25	15.00	16.25	15.00

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	**$29.00**	**$30.00**	**$31.00**	**$34.00**
3x6 and 8	**29.00**	**30.00**	**31.00**	**34.00**
4x4-6 and 8	**29.00**	**30.00**	**31.00**	**34.00**
3x10 and 12	**29.00**	**30.00**	**31.00**	**34.00**
3x14	*33.00*	**33.00**	**35.00**	**37.00**
4x10 and 12	**29.00**	**30.00**	**31.00**	**34.00**
4x14	*33.00*	**33.00**	**35.00**	**37.00**

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	**$31.00**	**$33.00**	**$35.00**
6x14	**36.00**	*36.00*	**40.00**
8x10	**31.00**	**33.00**	**35.00**
8x14	36.00	*36.00*	**40.00**

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	**$48.00**	**$49.00**		
3x10 to 10x10	**50.00**	**51.00**		
3x12 to 12x12	55.00	56.00		
3x14 to 14x14	**63.00**	**64.00**		
3x16 to 16x16	**70.00**	**71.00**		
3x18 to 18x18				
4x20 to 20x20				

* Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	**$53.00**	**$50.00†**	**$50.00**	**$50.00**	**$63.00**	**$60.00†**
Seattle		29.50				23.50
New Orleans	32.00				43.00	
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00			60.00	65.00
Los Angeles		37.00				38.00
Denver		*34.75*	*34.75*	34.75		*35.75*
Minneapolis	42.00	39.75	39.00		44.50	39.75
Atlanta	31.00				34.00	
Dallas	52.25				56.00	
Kansas City	42.50	31.00			53.50	32.00
Birmingham	32.00				34.00	
Philadelphia	60.00	*31.00*	*38.00*	*38.00*	68.50	*31.00*
Detroit	47.75	52.75			57.75	52.75
St. Louis	39.00				51.00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	**$46.00**	**$43.00†**	**$44.00**	**$50.00**	**$48.00†**
Seattle		25.00			29.00
New Orleans	80.00			42.00	
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles		32.00			81.00
Denver		35.25	35.25		*31.75*
Minneapolis	44.00	37.75	35.50	38.00	35.25
Atlanta	19.00			29.00	
Dallas	52.25			*55.75*	
Kansas City	77.00	73.00		65.00	74.00
Birmingham				63.00	
Philadelphia	33.50	*30.00*	*37.00*	62.00	*31.00*
Detroit	*37.75*	39.00		46.50	*39.75*
St. Louis	45.00			32.00	

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Mar. 5	One Month Ago	One Year Ago
$2.15@2.25	$2.05@2.15	$2.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.18@.22	New Orleans	$0.23½
New York	.22	Los Angeles	.19
Chicago	.21½	Seattle	.17
Minneapolis	.25½	St. Louis	.23½
San Francisco	.23	Montreal	.16
Atlanta	**.27**	Detroit	.19
Denver	.25	Baltimore	.18
Cincinnati	.21	Kansas City	**.21½**
Dallas	**.31**	Birmingham	.19@.21
Philadelphia	.19		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.225	.25
Kansas City	*.215*	*.225*
Seattle	.165	.19
Chicago	.1525	.1775
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.23	.255
New Orleans	*.233*	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.45
Sulphate of copper, in bbl., per 100 lb.	**4.75@4.80**
Soda ash, 58%, in bags, per 100 lb.	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b. works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	**2.00@2.35**

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.19	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.